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# Cultural Resources Overview

## Little Colorado Area, Arizona

Fred Plog

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# CULTURAL RESOURCES OVERVIEW:

# LITTLE COLORADO AREA, ARIZONA

by

**Fred Plog**

For

Apache-Sitgreaves National Forests
Arizona Bureau of Land Management

1981

USDA Forest Service
Southwestern Region
Albuquerque, New Mexico

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# PREFACE

Since 1979 the Southwestern Region of the Forest Service and the Bureau of Land Managment in New Mexico and Arizona have been producing a series of joint cultural resource overviews. This is the first volume from the State of Arizona. It is also the first published overview by a researcher, Dr. Fred Plog, who has had many years of first hand experience with the data base from most of the overview area. This gives the overview a special flavor not characteristic of earlier works which tended to summarize the data gathered by others. Beyond Dr. Plog's intimate archeological familiarity with the region, he has worked with many projects in timbering and range management involving cultural resource sites. This background is brought together here in a series of chapters which discuss the prehistoric cultures of the overview area. Dr. Plog has also provided a discussion of the term "significance," as applied in Historic Preservation usage, derived from his experiences in the overview area but general enough to be applicable in other places. His final management chapter reflects considerable thought on how one articulates cultural resources with other resources and suggests ways for improving the management of cultural resources. We are pleased to make this volume available to managers and students of archeology alike.

Paul D. Weingart

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Director of Recreation
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Southwestern Region

# ACKNOWLEDGEMENTS

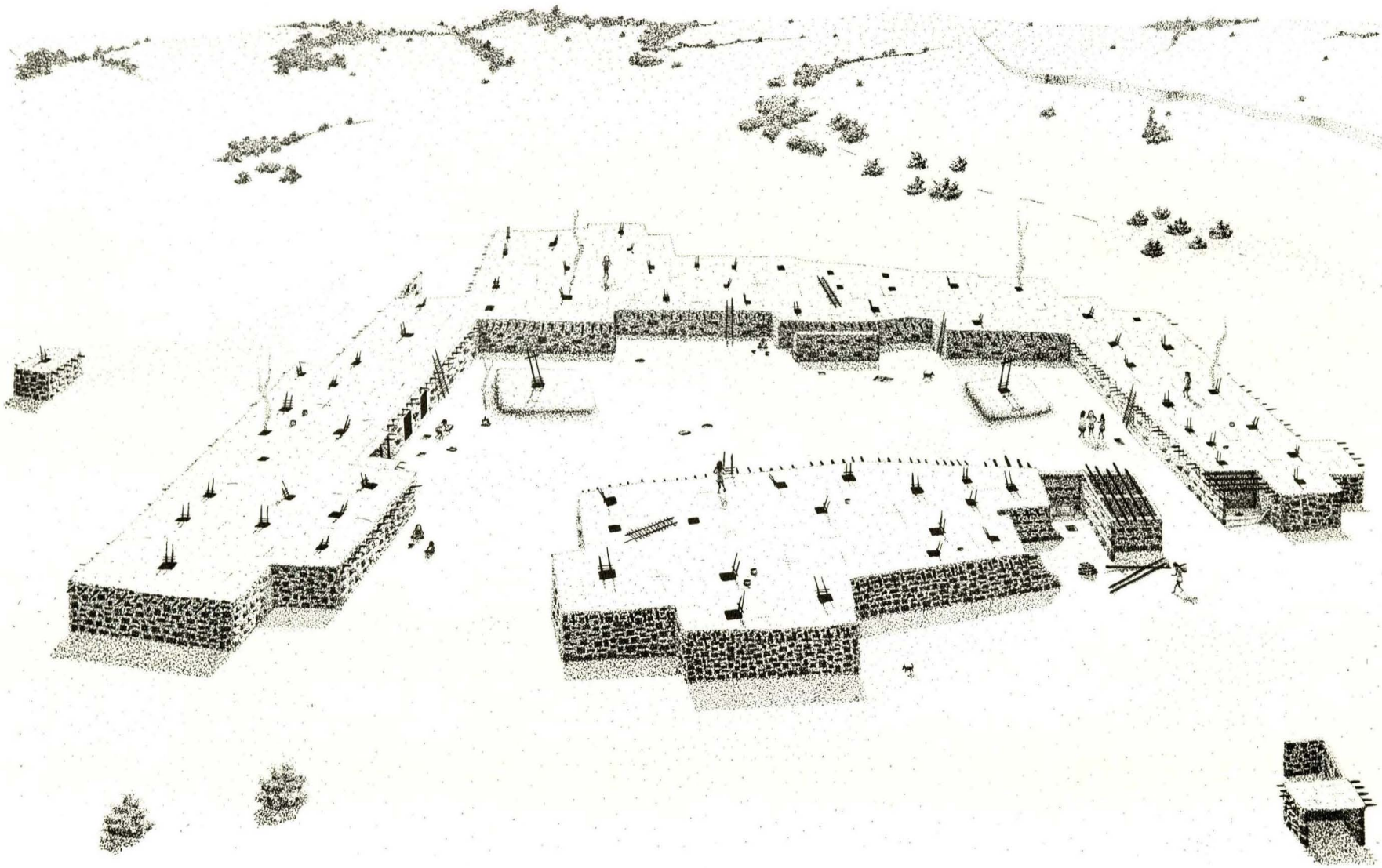
Identifying the contributions of individuals in a work that attempts as extensive a summary as this one is impossible. Clearly, the major contributors to the work are the many archeologists, student and professional, whose work has contributed to our understanding of the prehistory of the overview area. While I have sometimes been critical of particular efforts, even these analyses have helped in shaping basic perceptions of the past.

My own students have contributed to this study both through their own efforts to interpret the local past and through specific assistance given to me in preparing this document. Their critical evaluations of my ideas are the final, and probably most important, aspect of the contribution. While an enormous number of students have helped, the contributions of Judy Brunson, Jeff Hantman, Kent Lightfoot, and Steadman Upham were especially critical.

Without the foresight of archeologists and managers in federal agencies, this document would not exist. The help of Dee F. Green, Chris Kincaid, John Douglas, John Koen, and Paul Weingart have been especially important. Pat Giorgi and Bruce Donaldson, in addition to Green and Kincaid, provided valuable suggestions that greatly improved the document. While I have worked with many editors, I have worked with none more talented than David Gillio. My debt of gratitude to him is a substantial one. Jeff Boyer prepared some of the illustrations for the document, a contribution that I greatly appreciate. Polly Davis prepared the index, and Gassaway Brown helped with geological interpretations. Both my thanks and my apologies go to Donna Calkins who typed the final version.

I very much appreciate the help of all of the individuals at other institutions who aided me in gaining access to site records and other unpublished materials.

Finally, my greatest debt is owed to the late Paul S. Martin who introduced me to the prehistory of the area, shaped my early understanding of it, and challenged me to do better. This monograph is for Paul.



Artist's reconstruction of Broken K Pueblo.

# THE LITTLE COLORADO OVERVIEW UNIT

## INTRODUCTION

This document describes the prehistoric cultural resources of the Little Colorado Overview Unit. The unit is defined pursuant to a cooperative agreement between the USDA Forest Service and the USDI Bureau of Land Management. The agreement divides the State of Arizona into a series of overview units and designates one of the two agencies as lead for each (see Map 1). The goal of the agreement is the preparation of overview documents that generally follow the guidelines established in the BLM cultural resources manual, section 8111. The documents are intended to serve a number of purposes:

a) to guide in the assessment of cultural resource values within the study area,
b) to aid in the preparation of planning documents, and
c) to provide a context for the preparation of Class II sample surveys.

This particular inventory unit consists of portions of the Apache-Sitgreaves and Coconino National Forests and of the BLM Apache-Navajo Planning Unit (see Maps 2 and 3).

The Little Colorado Overview Unit covers an area of roughly 8000 square miles in north central Arizona. It is bounded on the north by the southern edge of the Navajo Reservation, on the east by the Arizona-New Mexico state line, on the south by the Mogollon Rim and on the west by an irregular line formed by the Navajo-Coconino County line to the northern edge of the Apache-Sitgreaves and Coconino National Forests, westward along that edge and then south along Highway 87 to the Mogollon Rim. Roughly 2000 square miles of the area is Federal land administered by the Forest Service, 340 square miles is administered by the Bureau of Land Management, and 680 square miles is State Trust land. Thus, of the total area, 36% represents government administered lands, and 64% is owned privately.

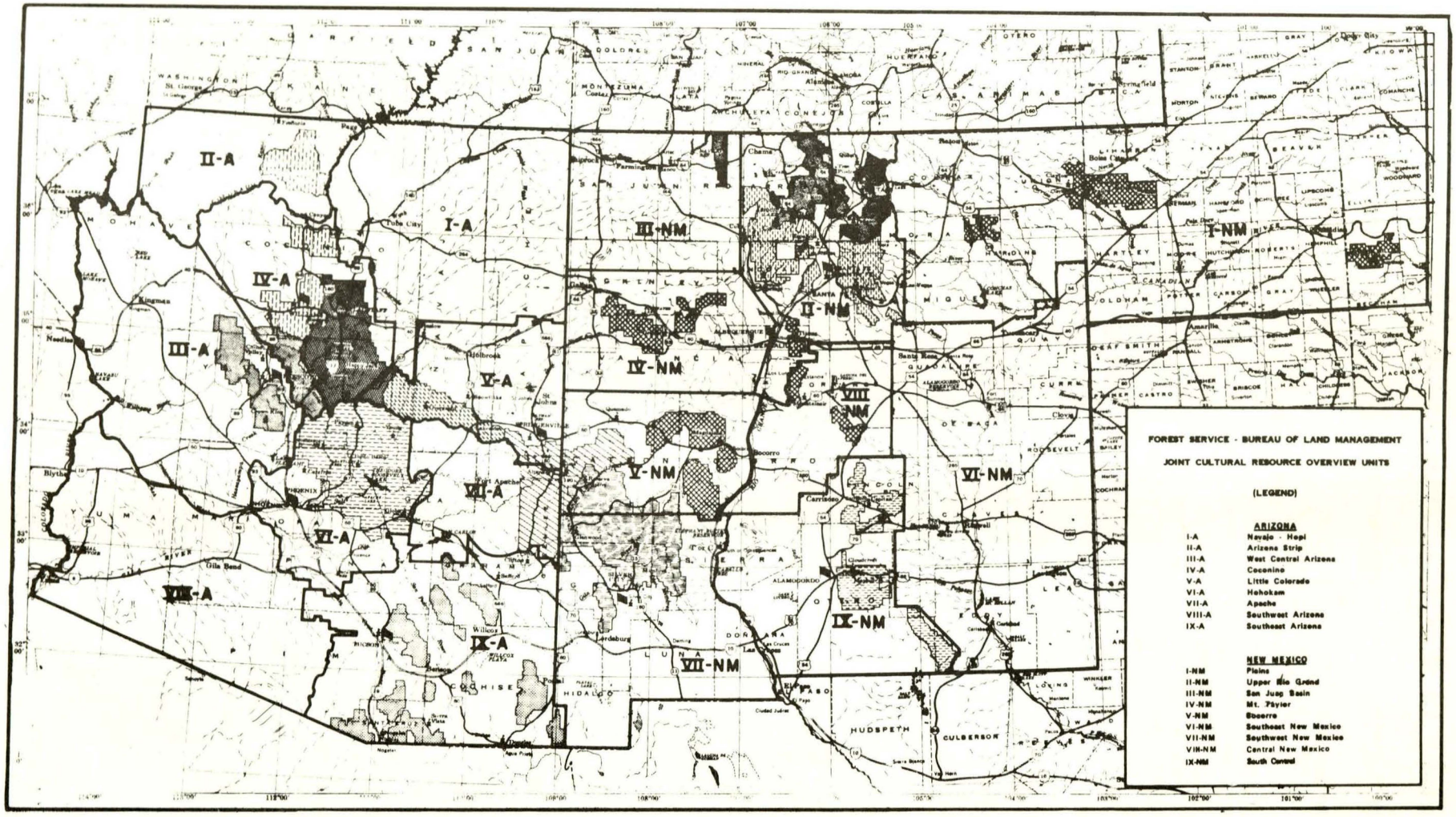
The study area lies on the Colorado Plateau in the southeastern and south-central portions of the Little Colorado River drainage. The southern boundary of the drainage lies within the study area. The highest elevations, at about 11,000 feet, are in the southeastern corner of the study area and the lowest elevations are in the northwestern corner. The entire Little Colorado Basin is an area of 26,977 square miles. In general, the land surface slopes gradually downward from southeast to northwest although there are occasional minor, and some major, changes of elevation. Thus, the study area is a drainage basin associated with a relatively large river. The study area and its major cultural and natural features are shown in Maps 2 and 3.

## GEOLOGY

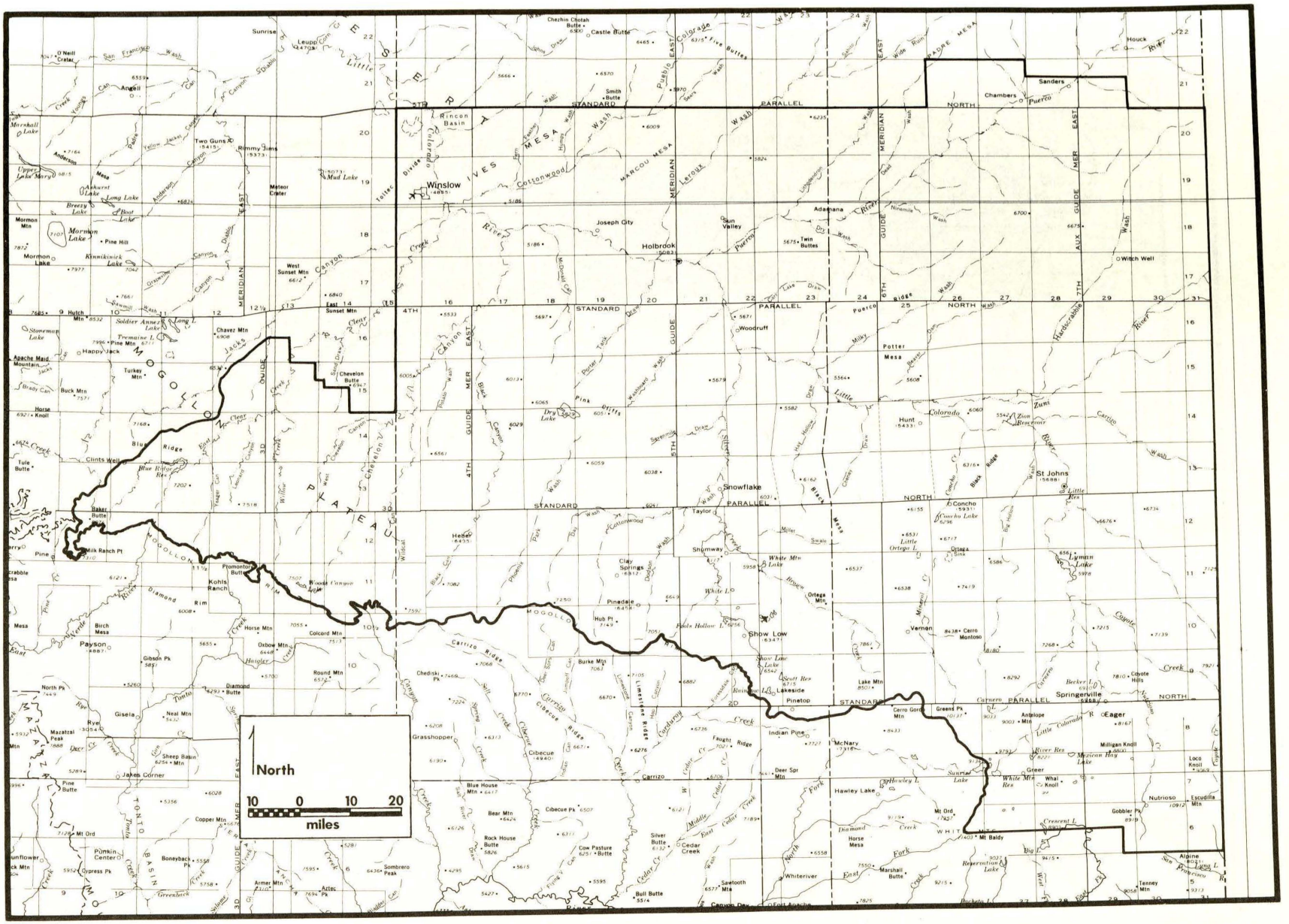
As one would anticipate given the substantial altitudinal variation, the geology of the area is complex. Figure 1 illustrates the major stratigraphic units used by geologists in describing the area. These are of importance to this study principally when they occur as surficial or near-surficial deposits. Given this perspective, the geology is best described in four categories or zones (see Map 4). The following discussion is based substantially on pertinent geological maps prepared by the Arizona Bureau of Mines (1960, 1967).

### Zone 1: The Basalt Highlands

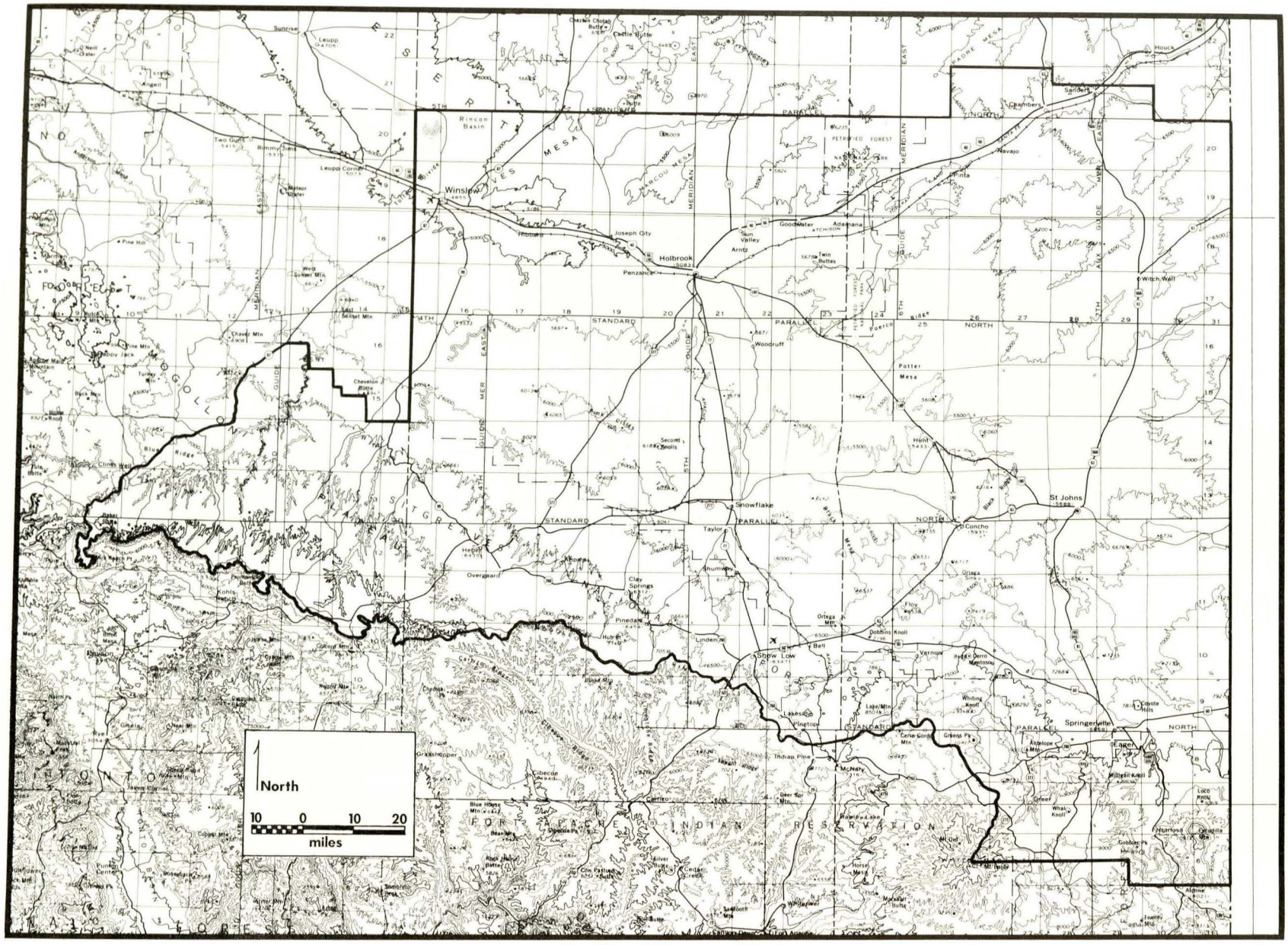
The Basalt Highlands lie in the southeastern corner of the study area. This zone is roughly bounded by lines running from Show Low north to Shumway, east to Concho, and then southeast to about 15 miles north of Alpine, Arizona. The predominant surficial and immediate subsurface deposits in this area are tertiary (upper peaks) and quaternary (lower cones and flows) basalt flows and cinder cones, with remnants of the largest of the volcanoes ranging up to 11,000 feet in elevation. In some more deeply eroded drainages, there are exposures of the Datil formation and also what Sirrine (1955) has called the Eagar formation of conglomerates, sandstones, and shales. Drainage bottoms are also commonly filled with quaternary and tertiary sediments derived from the parent materials mentioned above. Except in the deeper river valley and in the immediate vicinity of cinder cones, soil formation is minimal.




Map 1. Forest Service-Bureau of Land Management joint cultural resource overview units.




Map 2. The Little Colorado overview area: cultural features.




Map 3. The Little Colorado overview area: natural features.

Richville Formation: light brown, yellow-brown, and white mudstone, sandstone, gravel, conglomerate, caliche, travertine, and limestone.

Bidahochi Formation: white to light brown sandstone with minor interbeds of mudstone, siltstone and volcanic ash.

Datil Formation: black basalt flows interbedded with white volcanic ash, white sandstone and red to gray siltstone.

Eager Formation: red sandstone, shale, and conglomerate.

Mesa Verde Group: light yellow-brown, light green and red-brown sandstone and siltstone with some conglomerates. Local interbeds of coal.

Mancos Shale: dark gray shale and siltstone with thin interbeds of yellow-brown sandstone and siltstone.

Dakota Sandstone: light brown to yellow-brown sandstone and conglomerate. Often contains coal seams at or near base.

Chinle Formation: red-brown, purple, gray, green-gray interbedded sandstone, siltstone, and shale. Often contains petrified wood.

Shinarump Formation: yellow-orange to pale orange coarse sandstone and conglomerate.

Moenkopi Formation: red-brown to chocolate-brown interbeds of siltstone and shale.

Kaibab Limestone: dark gray to yellow-gray fossiliferous, silty-limestone with locally abundant chert nodules. Local interbeds of fine-grained sandstone.

Coconino Sandstone: light gray to white, fine- to medium-grained sandstone.

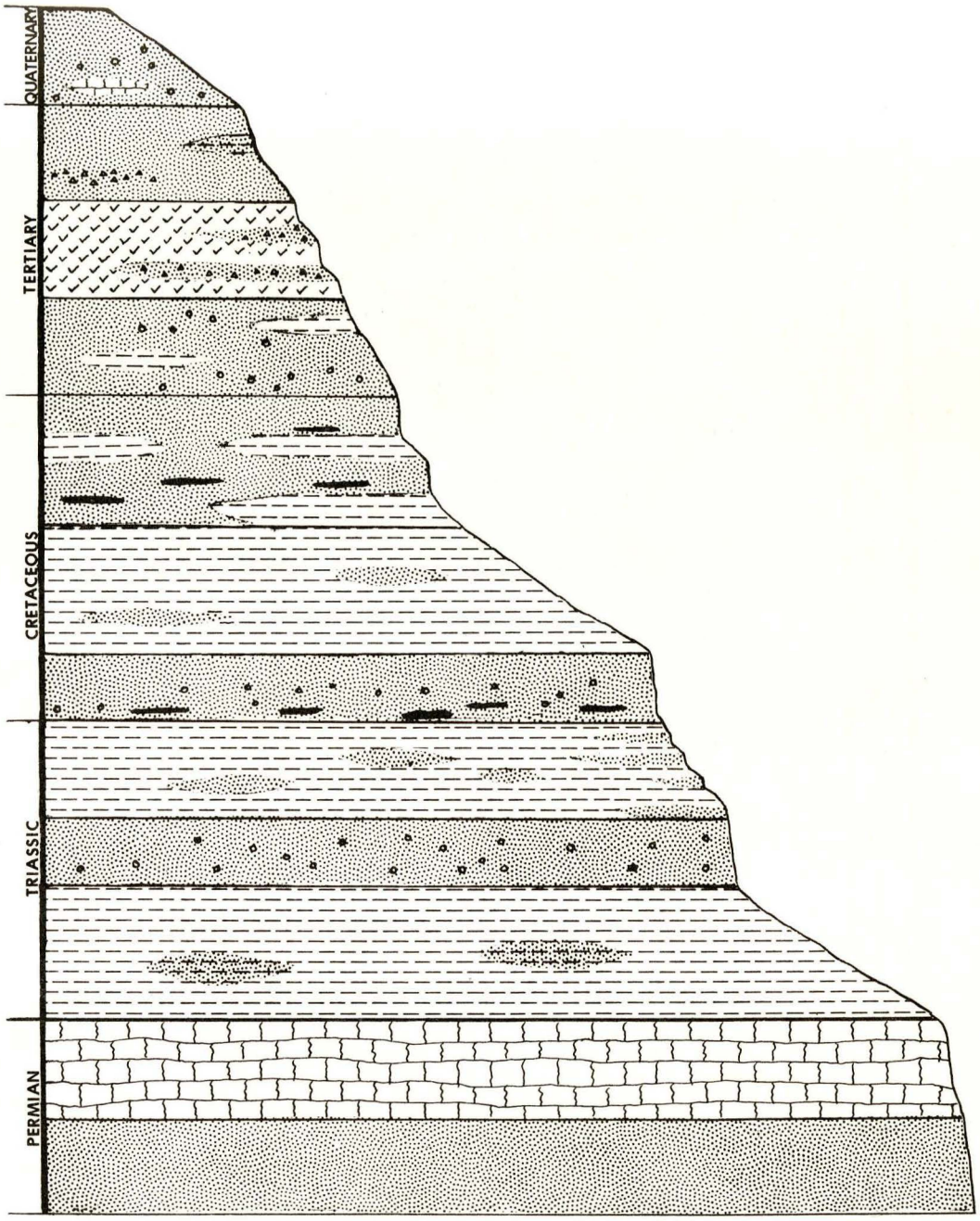
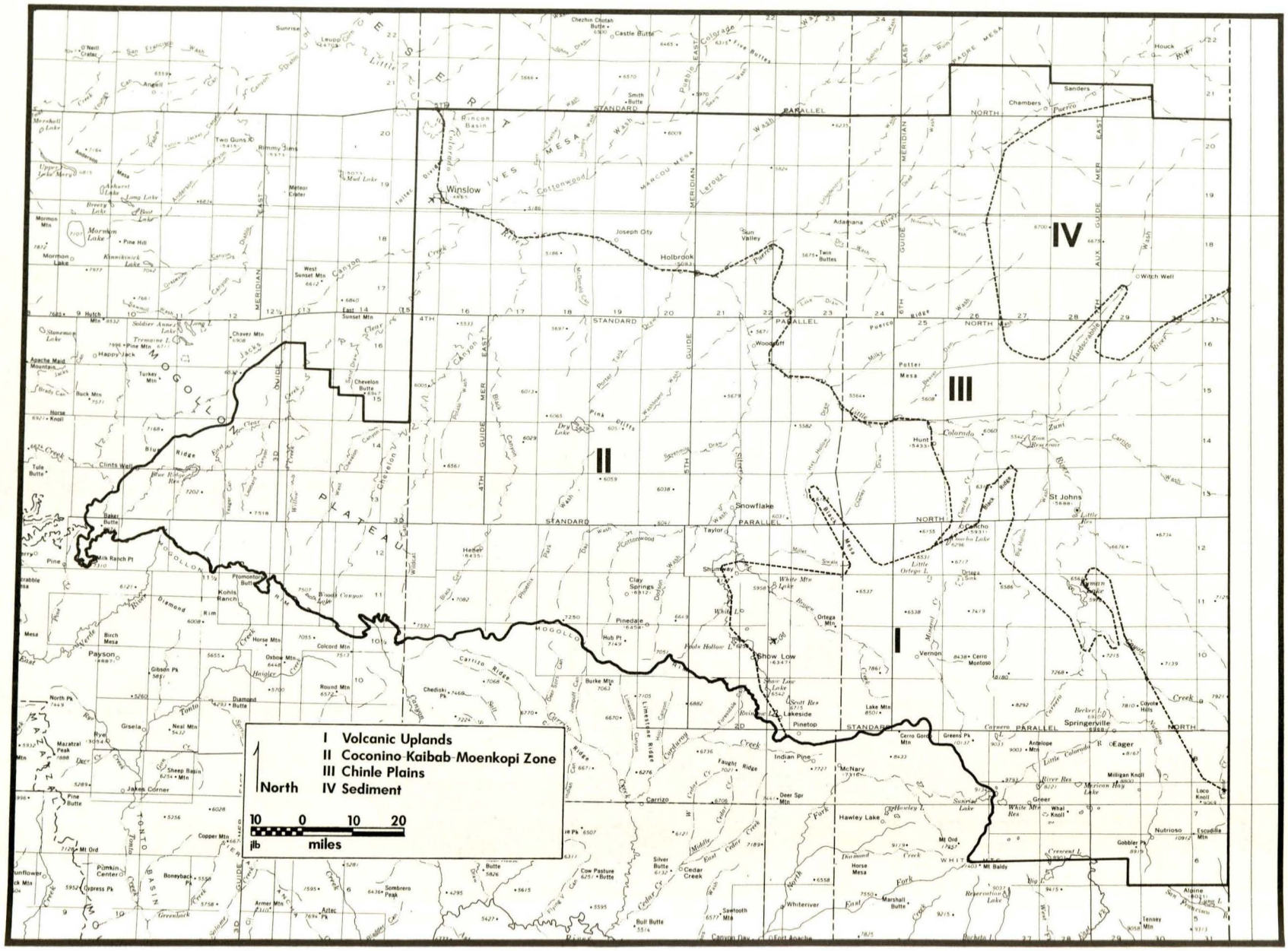



Figure 1. Geological sequence of the Little Colorado overview unit. (Formations not to scale.)




Map 4. Major geological zones of the Little Colorado overview unit.

### Zone II: Coconino-Kaibab-Moenkopi Uplands

The largest portion of the study area is occupied by this zone which lies generally to the south of the Little Colorado River and to the west of the Basalt Highlands. Outcrops of the Moenkopi Sandstone and Kaibab Limestone and soils derived from these are most typical of this area. These are generally thin and unproductive soils.

The extreme southern end of the zone, along the Mogollon Rim, is typified by Moenkopi Sandstone and Mogollon "Rim Gravels" and sediments and soils derived from them. In the southeastern portion of the zone between Linden, Aripine, and Zeniff, Arizona, there are extensive areas covered by relatively deep quaternary and tertiary gravel deposits. Occasional basalt flows meander into the zone from the Basalt Highlands, and there are roughly a half dozen isolated cones or flows.

### Zone III: Chinle Plains

Immediately to the north of the Little Colorado River is an area where the predominant circumsurficial materials are derived from deposits of the Chinle Formation of which the Painted Desert and the Petrified Forest are a part, although the latter are more colorful than the majority of areas. Occasionally, along the major drainages, there are relatively extensive zones of Quaternary and Tertiary sediments. At its extreme northeastern tip the Dakota Sandstone and the Mesa Verde Group are exposed along with a few zones of basalt flow. Over much of the area the soil formation is close to nil with decomposed Moenkopi sediments forming the ground surface.

### Zone IV: Sediment Zone

The headwaters of Hardscrabble Wash and the Puerco River and its tributaries in the extreme northeastern sector of the study area are overlain by deep quaternary and tertiary sands, silts, and gravels. These areas are poorly described and specific characterization of their geological characteristics is not possible at present.

### Other Considerations

More recent geological events in the study area are poorly described. Cooley and Hevly (1964), Hevly (1964), and Bowman (1975) have discussed erosional sequences in two areas, both of which lie within the Coconino-Kaibab-Moenkopi Uplands as defined above. While the most recent epoch of vulcanism in the area can be bracketed at 2,000 to 1,000,000 years ago, it is currently impossible to be any more specific. Finally, the highest points in the Basalt Highlands were affected by glaciation as recently as late Wisconsin times (terminal Pleistocene) and again at some time between 2500 and 6800 BP (Merrill and Pewe 1972). Nevertheless, much remains to be known of the nature of natural processes during late Pleistocene and early Holocene times.

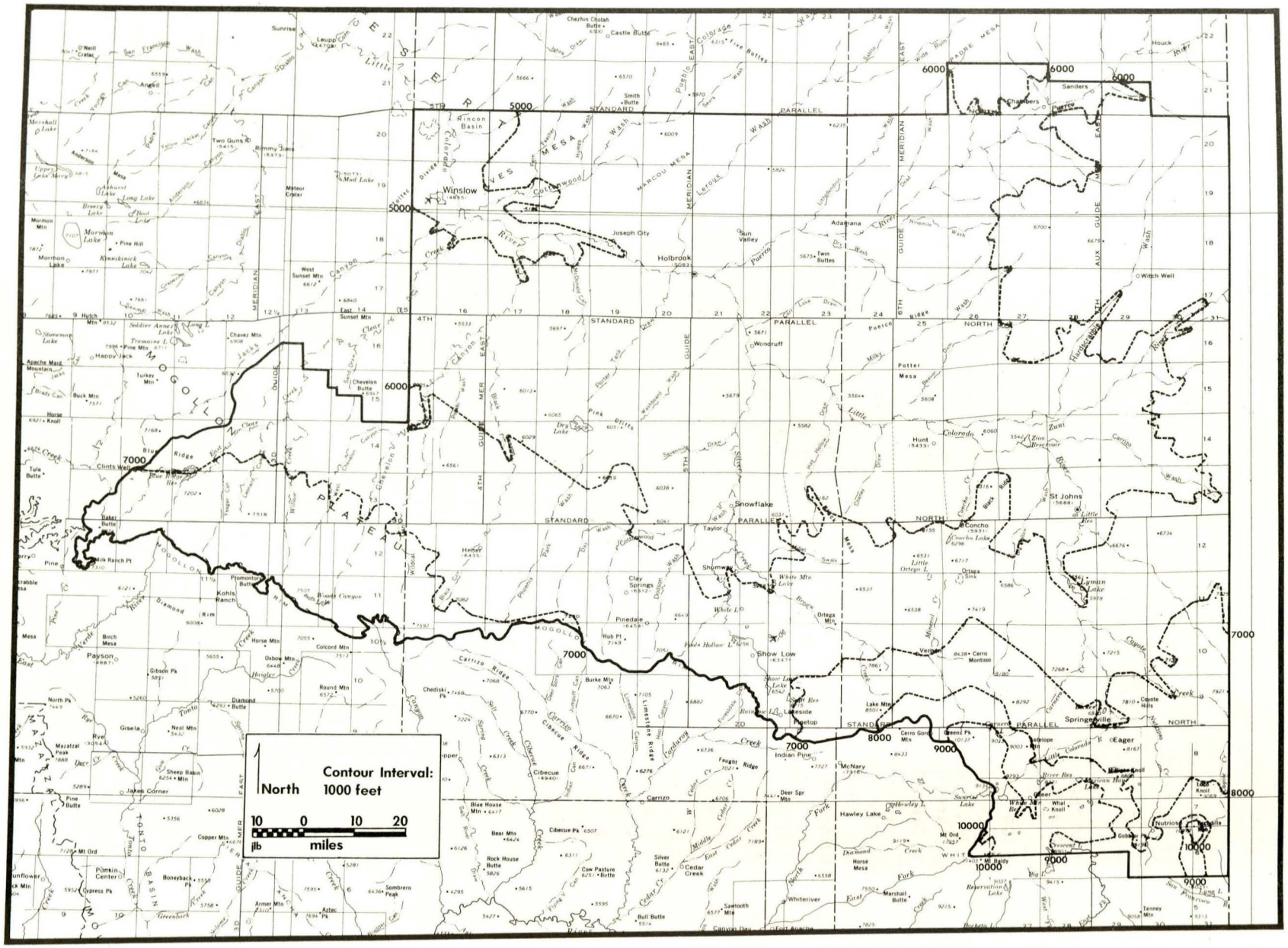
The area is not rich in mineral resources. Managanese occurs in a few localities along the Mogollon Rim at the western end of the overview area. Two occurrences of copper have been noted just east of Lyman Lake and near the end of the study unit almost due north. Salt occurs in sporadic deposits north of St. Johns and Concho.

## TOPOGRAPHY

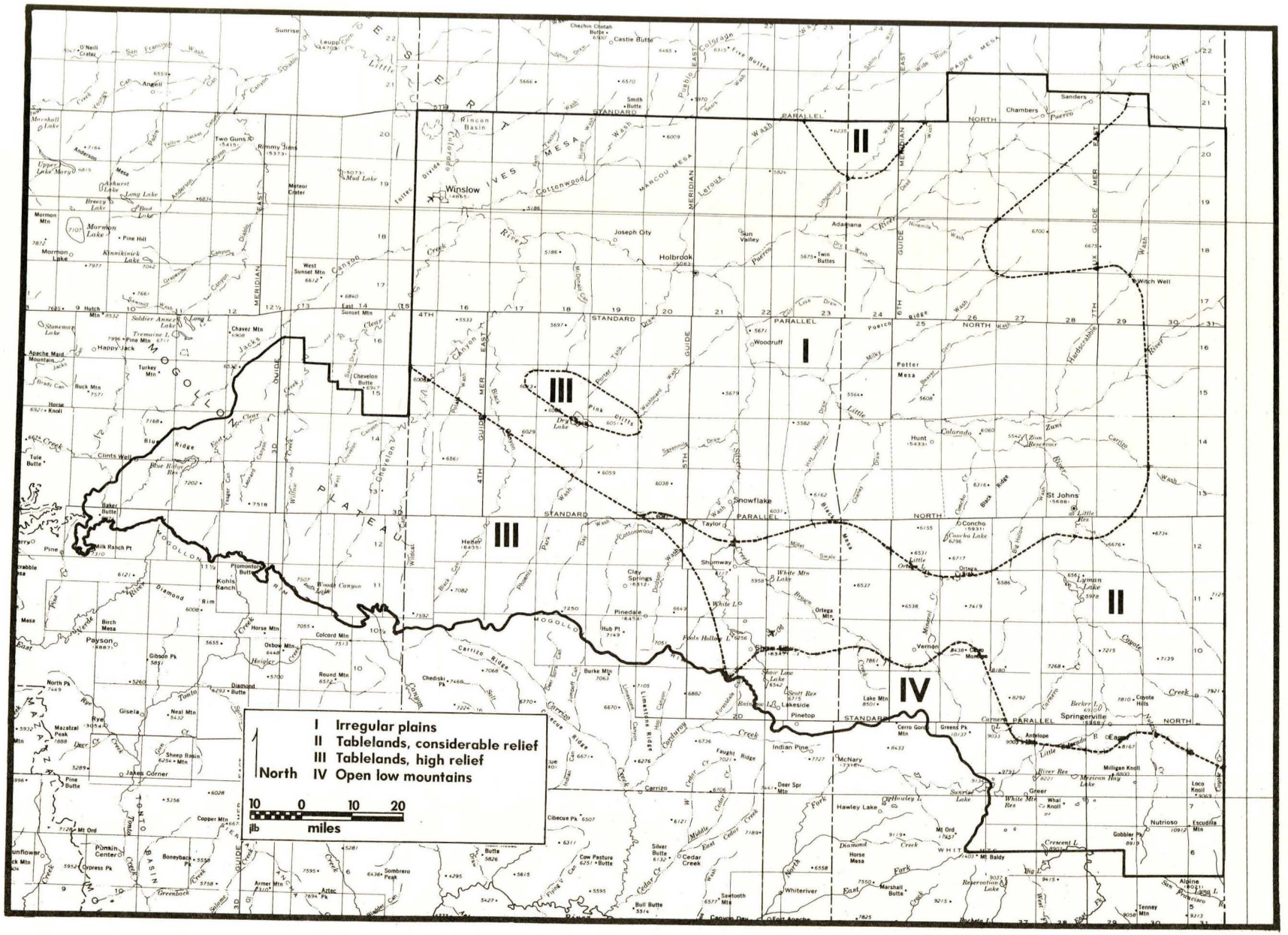
As noted earlier, the basic topographic configuration of the study area as a whole is that of a basin. As indicated in Map 5, the margins of the basin lie within the study area at its high southern and eastern extremes with the southeast corner as the highest portion of the study area. Following the Hammond system (1962), the area can be subdivided into a series of discrete categories (see Map 6).

In the southeastern corner of the study area is a zone best defined as open low mountains formed by vulcanism. Twenty to fifty per cent of the land surface is gentle; relief averages between 1000 and 3000 feet within a radius of a few miles, and most of the gently sloped land is on upland (as opposed to valley bottom) surfaces.

To the north of this zone is an area of tablelands with considerable relief. Fifty to eighty percent of the land is gently




Map 5. Elevation of the Little Colorado overview unit.




Map 6. Major topographic zones of the Little Colorado overview unit.

sloping and most of this land is on upland surfaces. Relief locally is generally on the order of 500 to 1000 feet. The area is actually highly variable in terms of the specific landform configurations. Ridges, cones, buttes, and deeper and wider as well as narrower and shallower valleys all occur.

The zone forming the remainder of the southern boundary is one of tablelands with high relief. There are two major differences between this and the preceding zone. First, local relief is typically more on the order of 1000 to 3000 feet. Second, the zone consists of a relatively monotonous series of parallel and north-trending ridges. Some major ridge zones are separated by deeply cut canyons but have the same parallel ridges between them.

The center of the study area is a zone of irregular plains. Fifty to eighty percent of the land is gently sloped, again with most, upwards of fifty percent, of the gently sloped land on upland surfaces. Local relief is minimal, however, rarely more than 100 to 300 feet.

## PRECIPITATION

Average annual precipitation at recording stations in the study area varies from about 7.5 inches at Holbrook and Winslow to 24 inches at Alpine (see Map 7). Mountain peaks above Alpine receive upwards of 30 inches. In general, precipitation is closely correlated with elevation (r=.86) (Johnson 1974). This correlation is best along the Mogollon Rim. Rainfall is both lower and less clearly correlated with elevation in the lower central portion of the study area.

The most outstanding characteristic of precipitation patterns in the area, however, is their extreme variability. Both spatially and temporally, there is little that can be said to be typical of any portion of the basin. Let us consider temporal variation first.

Precipitation is not evenly distributed over the year. It falls principally during a summer monsoon period lasting from July until September and during the period of peak winter continental storms between December and March. May is generally the driest month of the year. Winter precipitation tends to be more variable than summer precipitation both overall and in relation to elevation.

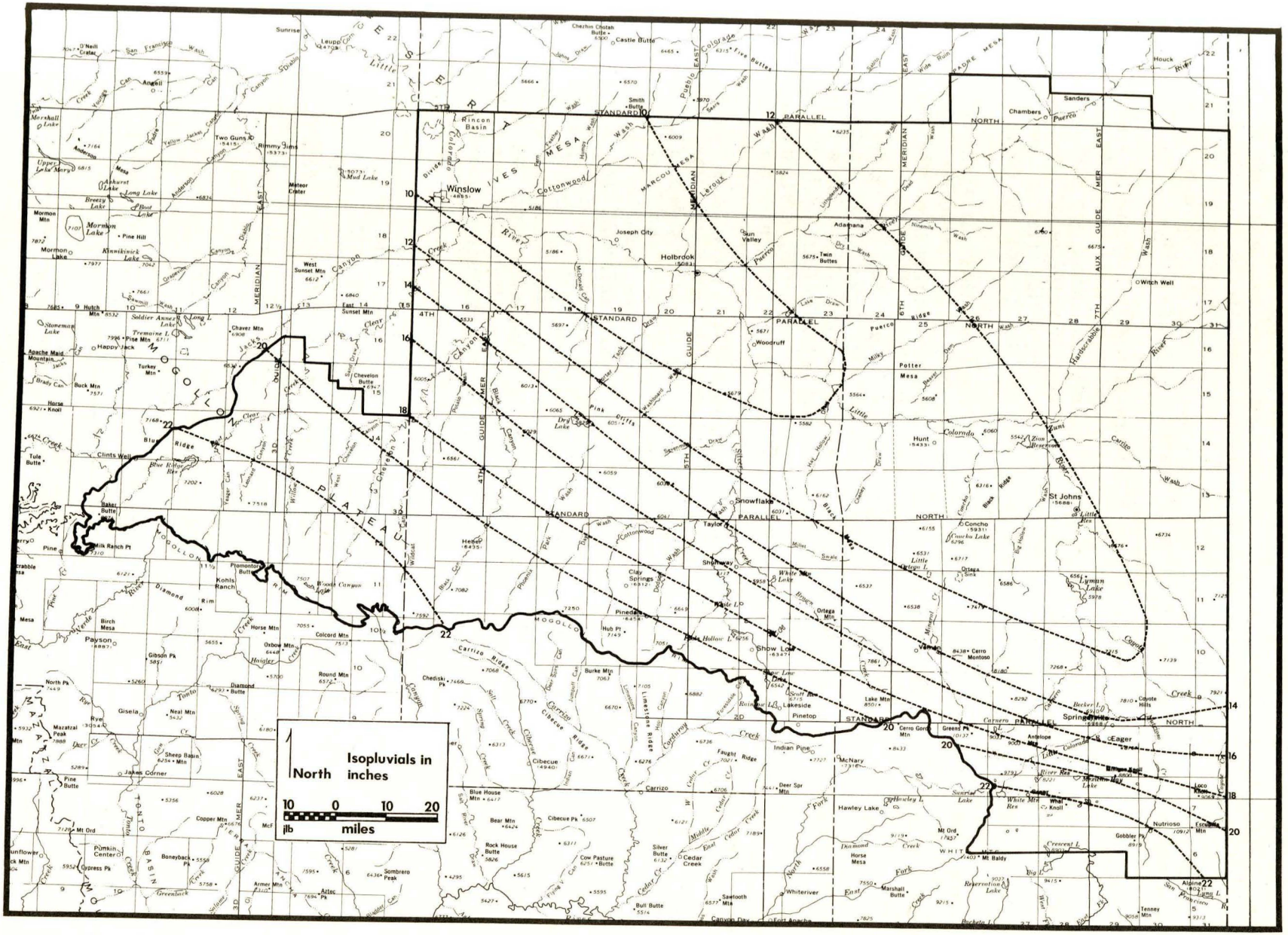
Spatially, extremely high and low departures from the average precipitation are constant throughout the study area. There is a general tendency toward somewhat less deviation from yearly averages in the northern and eastern sectors of the study area. Higher areas have more precipitation than lower ones in the driest years, but not in the driest summers. Minimum April and June precipitation is greater in the eastern and southern highlands area. There are fewer years with less than 75 percent of normal precipitation in this same area. When precipitation gradients that are more substantial than normal occur in the area, these normally separate the northeastern and eastern edges of the study area from the remainder. Such departures are most likely in November, March, May, June, and July (the preceeding is drawn from Visher 1954).

Yet, even these data fail to convey the full complexity of the variability. The average summer storm that passes through the area has a diameter of about 10 miles with several 1 to 3 miles diameter cells actually producing the rain (Johnson 1974). Thus, a given storm will water one area but leave another only a few miles away quite dry.

The effect of this pattern may be seen by comparing the precipitation records of Pinedale and Holbrook. Using 5-year running averages, there are 7 precipitation peaks evident in the Pinedale record between 1921 and 1971 (Lightfoot 1981). During these high years, Holbrook was also high in three but was low or average in four. During six years of low precipitation in Pinedale, Holbrook was high or above average in four and also low in only two. This is not to argue that the precipitation patterns in the two communities are negatively correlated. More accurately, they simply vary randomly in relation to one another, despite the long term correlation of rainfall with elevation. Any other pair of communities might also be expected to vary randomly, although some communities will vary proportionally and some inversely.

## TEMPERATURE

Temperature, like precipitation, varies




Map 7. Precipitation variability in the Little Colorado overview unit (after Greenwood 1960).

closely with elevation (r=.88, Johnson 1974). Average January temperatures are about 32° F. at lower elevations and about 28° F. at higher elevations. Average July temperatures are around 76° F. at the lowest elevations and 64° F at the higher. Thus, variation is somewhat more pronounced during the summer. Extremely cold, below zero, temperatures occur throughout the study area during the winter months. Map 8 illustrates the clinal pattern of temperature variation. The only notable difference from the distribution of precipitation is the markedly less sharp variation immediately along the Mogollon Rim.

Variation in the length of the growing season is somewhat different from that for temperature (see Map 9). The longest growing season (over 160 days) occurs immediately along the northeastern edge of the study area. The shortest growing season is along the Mogollon Rim where a season of 100 to 120 days is typical at lower elevations and less than 100 days at the highest.

In the lower elevations of the Little Colorado River Valley, a growing season of 160-plus days is characteristic, while the average is around 150 days in the surrounding foothills. Deviations from these averages, especially at higher elevations, are substantial. At Pinedale, for example, a growing season as short as 103 days is likely in one year out of four, and a season as short as 87 days in one year out of 16 (Lightfoot 1981). Virtually the same conditions prevail at McNary and can be expected to be even more extreme at higher altitudes.

## HYDROLOGY

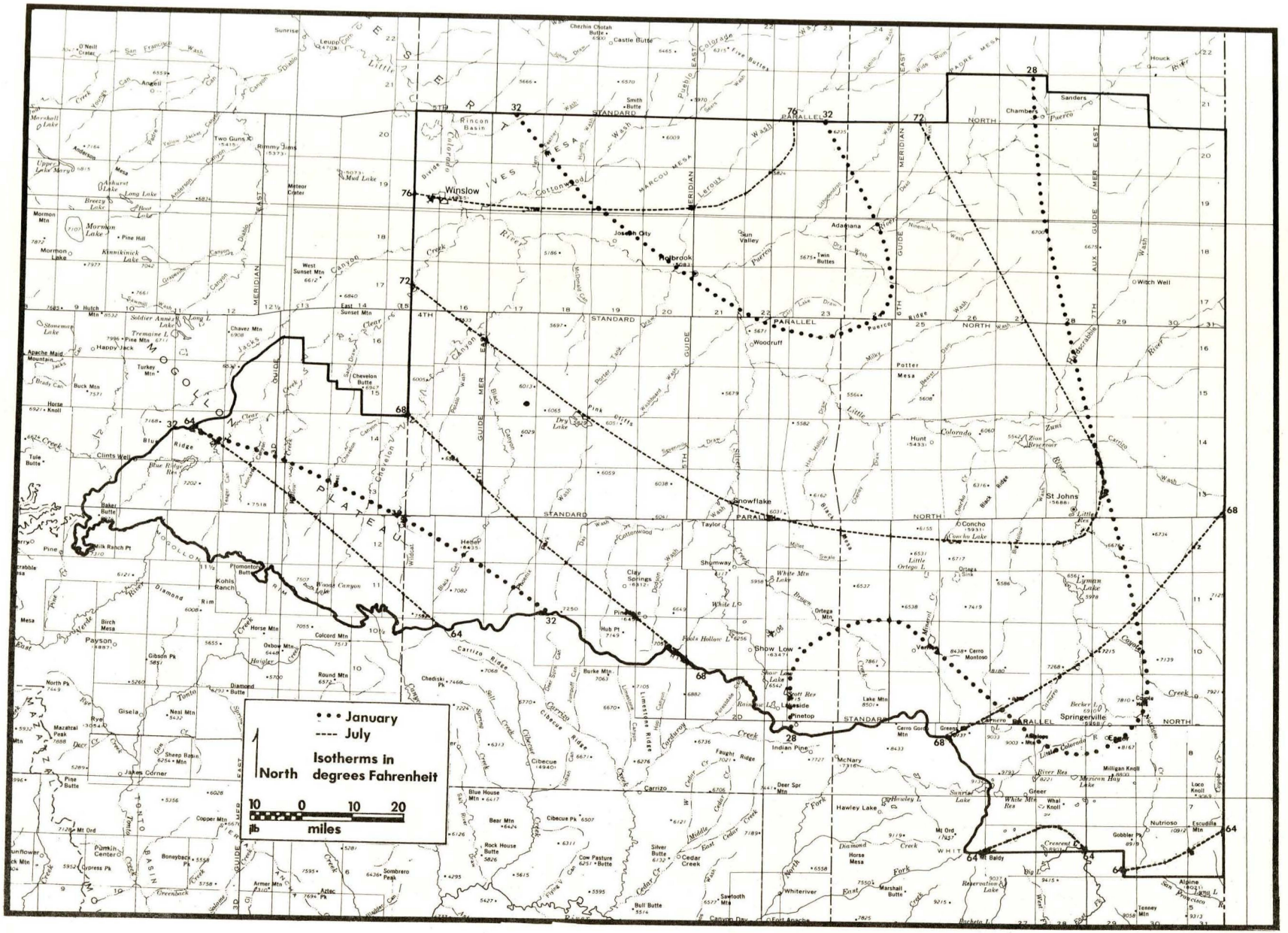
Hydrological data are important both as a means of assessing the availability of surface waters in the study area and because, in an area where recording stations are sparse, they provide backup information concerning the distribution of precipitation (the following discussion is based on Johnson 1974).

The pattern within the study area is basically one of boom and bust. At any point in time, most drainages are carrying either a great deal of water or no water at all. Of course, there is often a subsurface flow that can be tapped by digging a well.

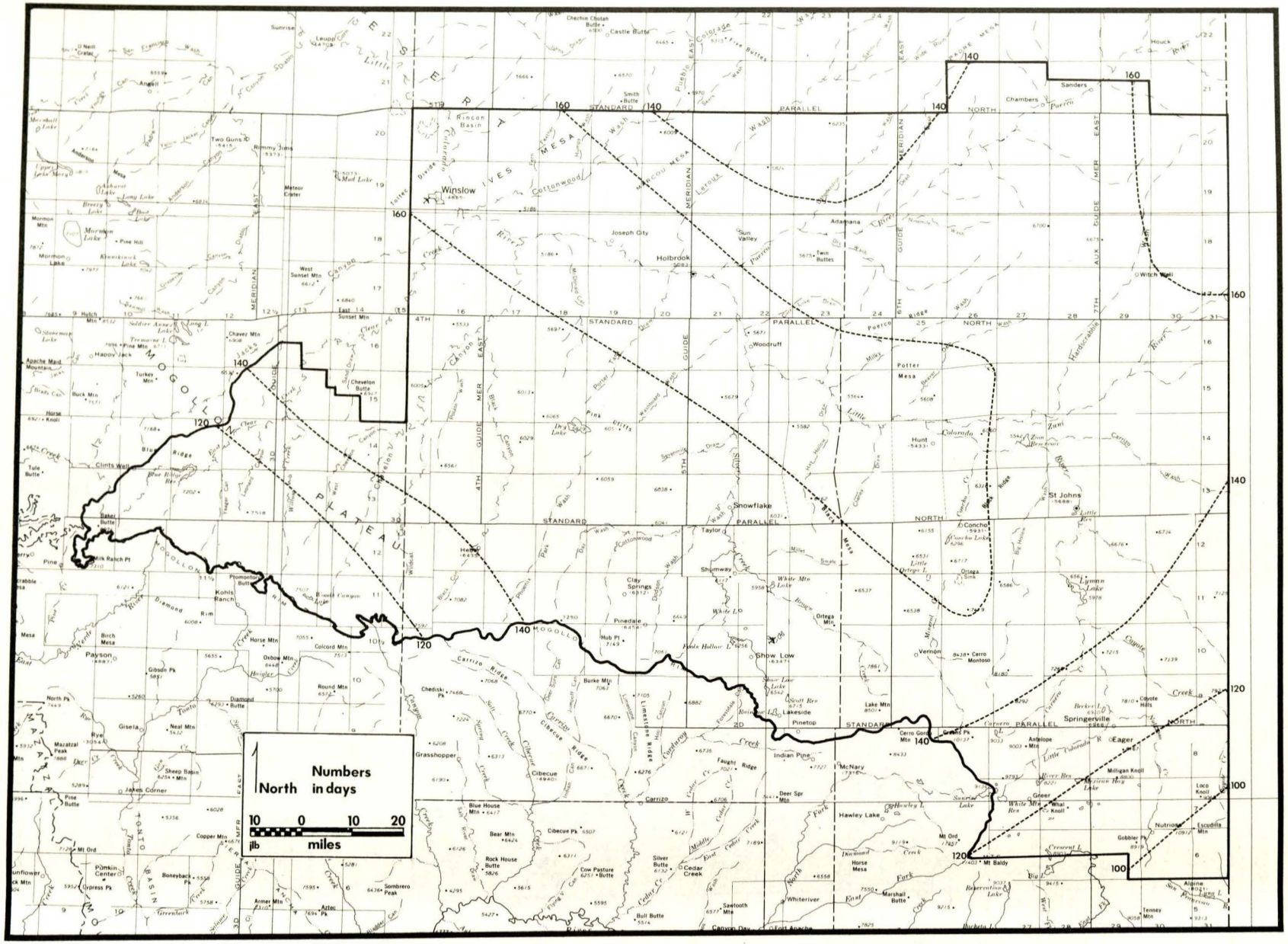
The extent of this variation is indicated in Table 1. Of particular importance is the relationship between the maximum and minimum flow. The values indicate that maximum values for the recorded drainages are on the order of 20 to 40 times the minimum annual value. Table 2 illustrates several other aspects of the variation. While one recording station is typically the lowest in the winter months (Zuni), it is not so typically the lowest during the summer months. There is in fact no pattern to where the summer low occurs. Similarly, while the highest stream flow in winter months occurs in Clear Creek, the highs in the summer are equally divided between Clear Creek, Holbrook, and Woodruff. It should be noted that Zuni, Holbrook, and Woodruff are all on the Little Colorado River. This indicates that a high stream flow at one point along the river course does not mean that the flow will necessarily reach a downstream point in the same abundance.

Table 1. Variation in stream flow in the Little Colorado overview unit

| | Mean Discharge/ Square Mile | Maximum Recorded | Minimum Recorded | Maximum / Minimum |
|---|---|---|---|---|
| Chevelon | 45.96 | 105,300 | 5560 | 18.94 |
| Clear Creek | 92.71 | 196,500 | 5050 | 38.91 |
| Silver Creek | 14.14 | 59,460 | 2,250 | 26.55 |
| Little Colorado | 20.92 | 51,870 | 2,130 | 24.35 |




Map 8. Variation in mean temperature in the Little Colorado overview unit (after Greenwood 1960).




Map 9. Variation in the number of frost-free days in the Little Colorado overview unit (after Greenwood 1969).

Table 2. Decadic variation in stream flow in the Little Colorado overview unit

| | Pre 1925 | 1925-34 | 35-44 | 45-54 | 55-64 | 65-73 |
|---|---|---|---|---|---|---|
| WINTER | | | | | | |
| Ratio | 5.12 | 5.30 | 15.23 | 64.20 | 36.30 | 44.48 |
| Lowest | Chevelon | Hunt | Zuni | Zuni | Zuni | Zuni |
| Highest | Holbrook | Clear Creek | Clear Creek | Clear Creek | Clear Creek | Clear Creek |
| SUMMER | | | | | | |
| Ratio | 14.6 | 112.03 | 98.27 | 15.92 | 16.71 | 22.88 |
| Lowest | Chevelon | Woodruff | Clear Creek | Clear Creek | Zuni | Zuni |
| Highest | Woodruff | Clear Creek | Woodruff | Holbrook | Holbrook | Clear Creek |

Table 3. Variation in seasonal stream flow in the Little Colorado overview unit by decade (Values are ratios to the overall mean for each recording station)

| | | Pre 1925 | 25-34 | 35-44 | 45-54 | 55-64 | 64-73 |
|---|---|---|---|---|---|---|---|
| | W | | | 1.41 | .76 | .75 | 1.37 |
| LCR-Lyman | S | | 1.21 | .94 | .85 | 1.12 | |
| | W | | | 3.01 | .51 | .52 | 2.42 |
| LCR-Zuni | S | | | .64 | 1.05 | 1.31 | .77 |
| | W | | 2.86 | 3.51 | .31 | .26 | .60 |
| LCR-Hunt | S | | 2.99 | .56 | .80 | .68 | .67 |
| | W | 3.47 | 1.78 | 1.09 | .58 | .45 | 1.09 |
| LCR-Woodruff | S | 1.45 | 2.14 | .65 | .93 | .82 | .83 |
| | W | 5.48 | | | .57 | .61 | 1.63 |
| LCR-Holbrook | S | .41 | | | .58 | .87 | 1.33 |
| | W | | 2.29 | 1.02 | .91 | .48 | 1.09 |
| Silver Creek | S | | 2.03 | .77 | 1.08 | .75 | .85 |
| | W | 1.01 | 1.05 | 1.20 | .94 | .79 | 1.08 |
| Chevelon | S | .82 | .57 | .58 | 1.16 | 1.33 | 1.22 |
| | W | 1.20 | 1.28 | .96 | .71 | 1.28 | |
| Clear Creek | S | .13 | .05 | .67 | 3.04 | .54 | |

LCR = Stations along Little Colorado River
W = Winter
S = Summer

The ratios between the high and low recording stations are also shown in the table. It is evident that variation is substantial. Table 3 illustrates the relationship of decadic summer and winter flows to the average for the recording station. While there is nearly always some drainage that experiences a shortage of winter stream flow, one or more drainages are at or above average in every decade except 1955-1964. One or more drainages are above average for the decade in every year when the summer figures are considered.

## SOILS

Given the complex variation in geology, precipitation, and stream flow over the study area, a complex distribution of soils is expectable. Defining the pattern of variation in soils is difficult; detailed soil maps exist only for some planning units on the National Forests, central Apache County, and some locations between Holbrook and Show Low. County level soil studies are too gross for local analyses and too detailed for regional generalizations. Thus, the description of soils presented herein is a composite of a variety of specific studies (USDA Soil Conservation Service 1959, 1964, 1972a, b, 1975). The distribution of different soils is shown in Map 10. Brief definitions are given in the key to Map 10. Map 11 shows the erosional pattern within the study area.[1]

These are, of course, zonal patterns. Azonal variation is substantial, perhaps best reflected in the fact that one of the more extensive soil zones is defined on the basis of alternating zonal and azonal patterns. Within most of the zones, there are at least small pockets, on the order of several acres, of moderately deep to deep noncalcareous sandy and/or loamy soils.

## VEGETATION AND FAUNA

The distribution of flora and fauna is elevationally zoned. There is little consistency in the manner in which specific zones have been defined. The pattern shown in Map 12 is derived basically from Lowe's study (1964). However, the subsequent discussions and definition draw heavily upon the Forest Service's study of the Mogollon Rim Planning Unit (USDA FS 1972) and the work of Aitchison and Theroux (1974). Major associations and plant communities occurring within them are defined in Table 4.

While these definitions account for modal patterns in the area, it is important to recognize that ecotonal distributions are substantial. There is, for example, a broad belt where a scrubland forms the transition between the juniper pinyon woodland and the desert grassland. Similarly, there is considerable variation in the relative percentages of different dominants. In some areas of the juniper pinyon woodland juniper is predominant, pinyon in others. It is not possible at present to describe the details of this variation. Examples of major associations are shown in Figures 2 through 5.

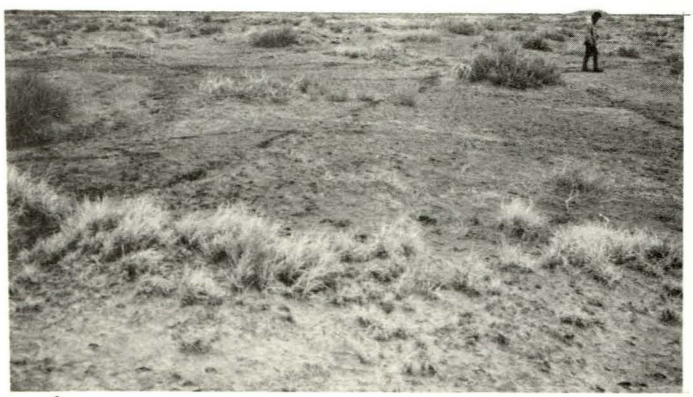


Figure 2. Desert grassland in the Little Colorado overview unit.

Figure 3. Grassland-woodland transition in the Little Colorado overview unit.

1. An erosion map that will apparently differ considerably from this one is currently under preparation by the Soil Conservation Service.

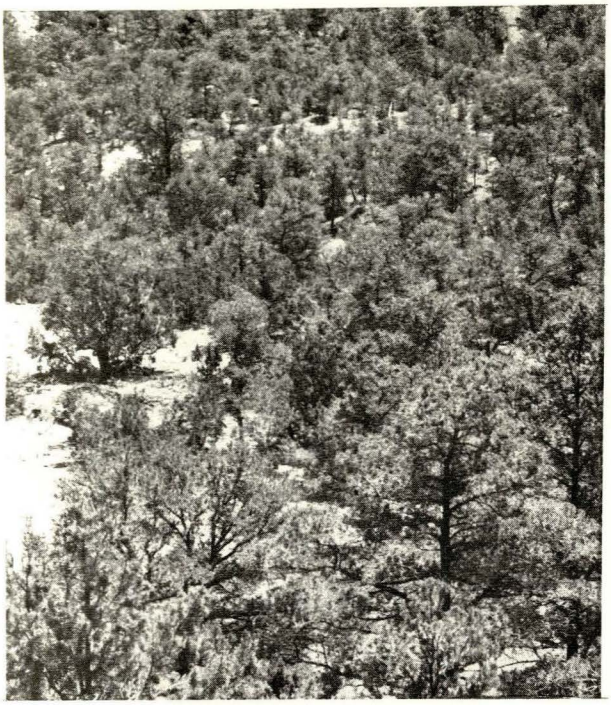


Figure 4. Woodland in the Little Colorado overview unit.

Figure 5. Coniferous forest in the Little Colorado overview unit.

Cross-cutting the major vegetative associations are riparian communities that cannot be mapped here because of their limited spatial extent. Three of these are of primary importance: cottonwood-willow, rabbit brush, and salix. Salix communities occur at the highest elevations and most frequently toward the eastern end of the study area. Especially along permanent streams, cattail, rushes, and tuberous plants occur. The cottonwood-willow association is typical of some of the larger canyons at higher elevations and toward the western end of the study area. In addition to cottonwood and willow, walnut and wild grape are characteristic. Species characteristic of the surrounding community are often present in greater than usual abundance. Rabbit brush communities, often mixed with sage and/or saltbush, are typical of riparian habitats in the juniper pinyon woodland and to a lesser extent in the grassland.

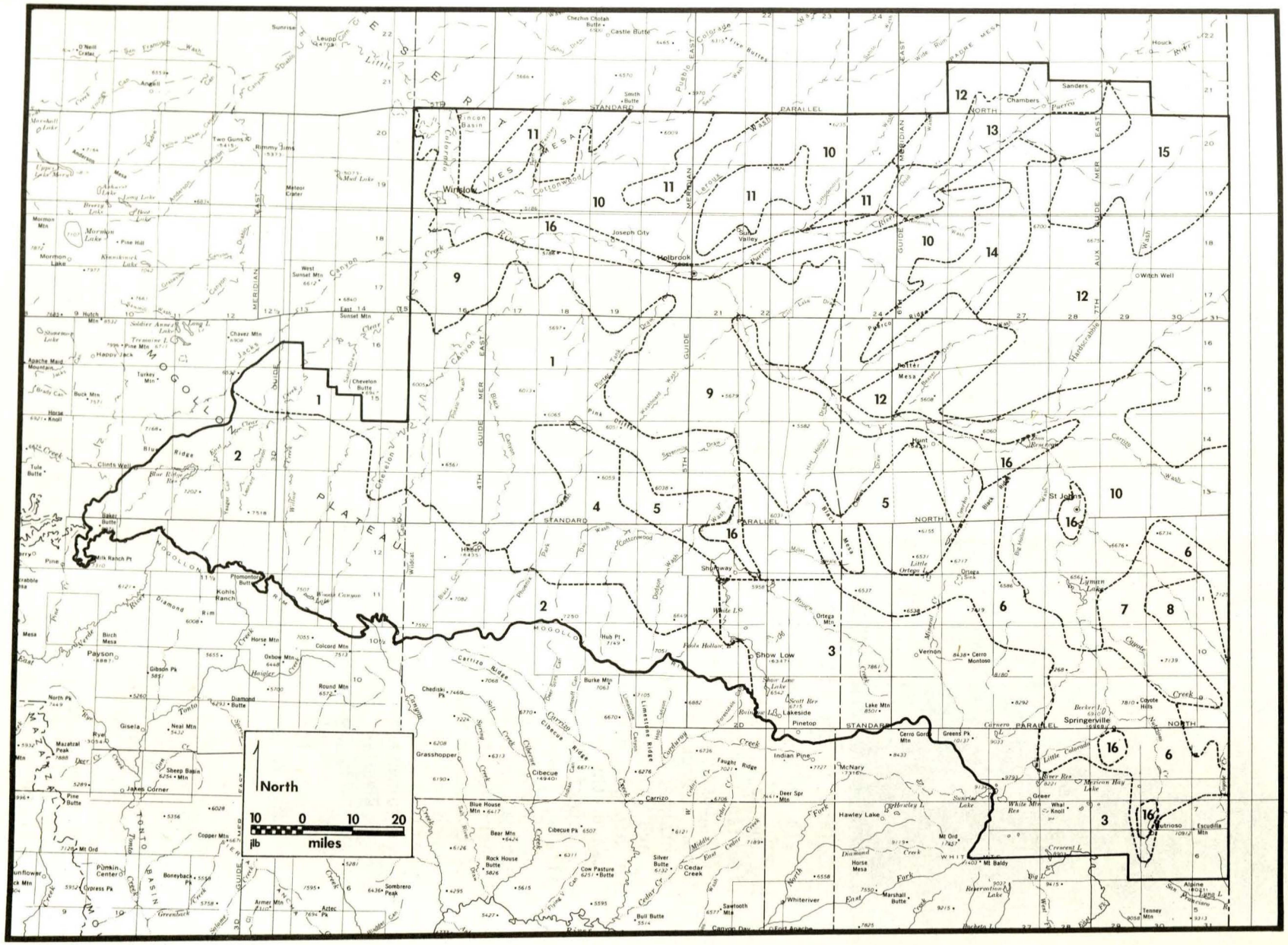
## RECONSTRUCTING PAST ENVIRONMENTS

It would, of course, be a mistake to assume that past environmental conditions in the area were identical to those of the present. At the same time, it would be a mistake to assume that the limits of past variation in all environmental categories are equal. It is clearly more expectable that the distribution of flora and fauna have changed than that there has been any major change in geological formations. Therefore, this discussion will briefly recapitulate each of the categories just discussed to identify areas where there is evidence for past conditions that differ from those of the present.

### Geology

There are few grounds on which one might anticipate any major differences between the manner in which the geology of the area has been described and a description that might have been written at any point in the last 12,000 years. The major deposits that cover the study area were in place by the time of earliest human occupation. There are two exceptions. As noted earlier, there was a period of glaciation at the highest altitudes between 2500 and 7000 BC. There were people in the general area during this period. However, since this high altitude area was never one in which people lived, the direct geological effect on their livelihood was probably minimal.

In addition, it is possible that there were volcanic eruptions in the area during the period of human occupation. If such eruptions occurred after AD 1, we would almost




Map 10. Soils of the Little Colorado overview unit.

Key to Map 10. Definitions of Major Soils of the Little Colorado Overview Unit (definitions verbatim or close paraphrase from USDA-SCS).

1. Soils are generally very shallow or shallow, but moderately deep in some places. They are medium to moderately coarse. Those developed on limestone are strongly calcareous. Locally, there are soils developed on the Coconino sandstone. The sandy material that weathers from the sandstone is removed by wind and water and deposited locally. Occassionally, the ground surface is rock outcrop.

2. Soils are deep to moderately deep. They are developed on sandstone, limestone, or rim gravel deposits. The surface soils are a cobbly loam. Variability is high from one locale to another within the area.

3. "Shallow and very shallow, stony, medium to fine textured, noncalcareous soils developed on basalt. Small areas of deep soils occur locally as well as medium textured, cindery soils on volcanic cinders. Basalt rock land is interspersed throughout the area."

4. "Shallow to deep soils developed on old sandy and gravelly alluvium. The surface soil is medium to moderately coarse textured and the subsoils are moderately fine to fine textured. Many of the soils are gravely throughout the profile. A lime accumulation occurs in the lower subsoil above which the soil is noncalcareous. Locally a clay soil is found where old calcareous claybeds occur. This soil may have a thin, moderately fine textured surface soil."

5. "The soils are dominantly shallow lithosols on shales and sandy shales. Large areas of rock land occur in local areas. There are dark colored pebbles on the surface. The textures vary from medium to moderately coarse."

6. "Very shallow to shallow soils developed on basalt. The soils are usually medium textured and strongly calcareous throughout. There is a zone of lime accumulation immediately above the bedrock on the underside of large boulders. The surface soil aggregates are moderately water-stable. Rock outcrops are common."

7. "Very shallow to deep soils. The parent material consists of sandstone and shales, a thin, discontinuous deposit of old sands and gravels on the sandstones and shales, and alluvium along the intermittent drainageways. There are shallow and very shallow residual soils on the sandstone and shales with included areas of rock land. Moderately deep to deep medium textured soils are developed on the old sands and gravels."

8. "Deep to moderately deep soils developed on old sand and gravel deposits. The sand and gravel parent material varies greatly in depth and rests upon sandstone and shales. Locally the gravels contain a fair amount of basalt. The surface soils are medium textured and the subsoils are moderately fine textured. The soils are noncalcareous in the surface soil and upper soil. Soils with gravelly surfaces and subsoils are more common than soils lacking gravel. A zone of lime accumulation occurs in the lower subsoil."

9. "Very shallow to moderately deep, highly calcareous, medium to moderately coarse textured soils developed in place on the Moenkopi formation of the interbedded sandstone and shale. Locally the parent material contains strata of gypsum. Deep, moderately coarse to moderately fine textured alluvial soils occur in the swales."

10. "The rapidly eroding vari-colored shales of the Painted Desert badland occupy 15 to 25% of the area. Moderately fine to moderately coarse textured deep alluvial soils occur on fans and narrow flood plains. Very shallow soils with pebbly surfaces and moderately fine textures have developed in places on shales."

11. Calcareous sands and moderately coarse to medium textured calcareous soils with a zone of lime accumulation in the subsoil. The parent material is moderately fine to moderately coarse, stratified old alluvium. The sands occur as low ridges and mounds.

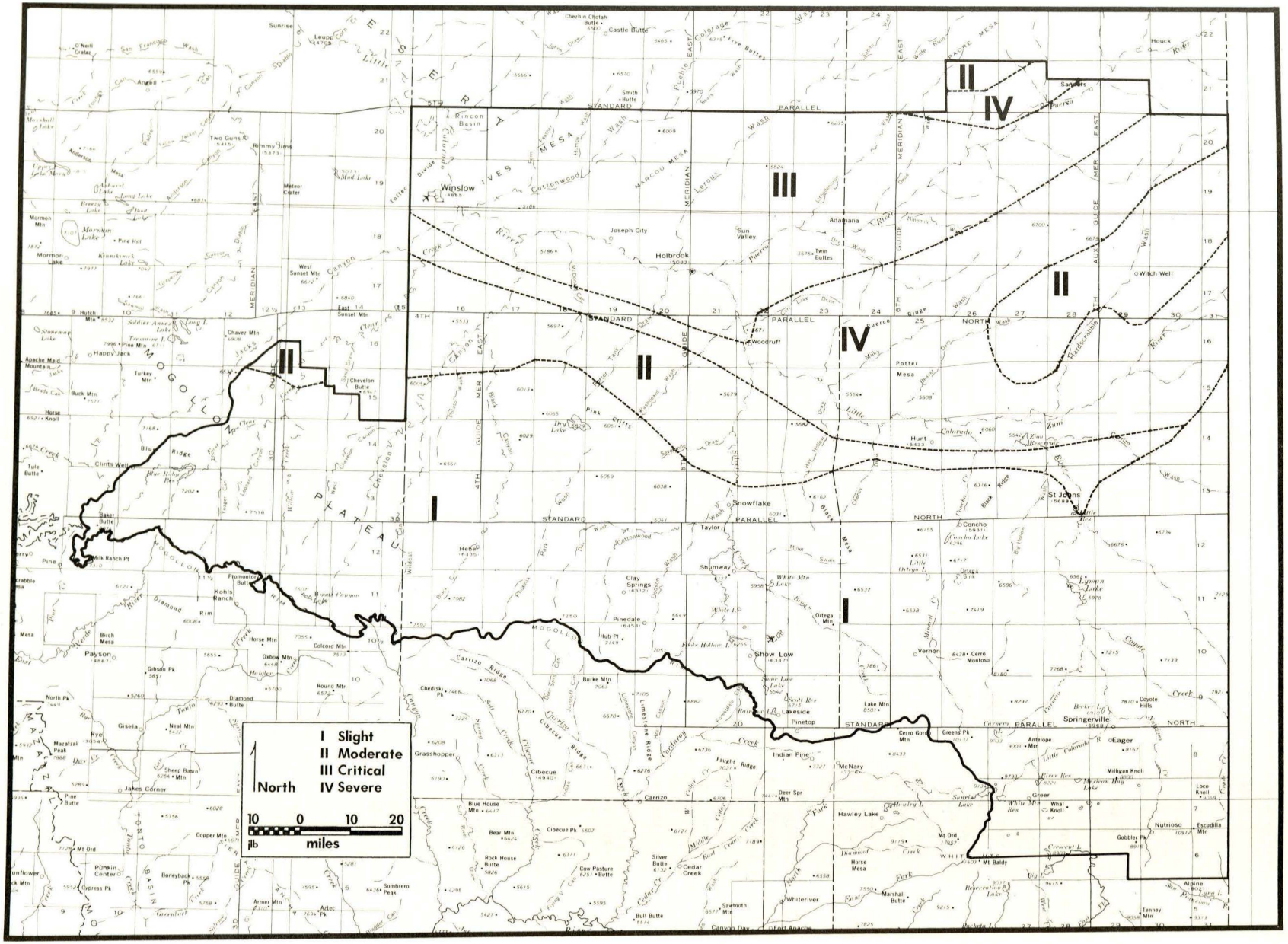
12. A complex pattern of zonal and azonal soils developed on moderately fine to moderately coarse textured stratified old alluvium. The zonal soils have medium to moderately coarse textured surfaces and medium to moderately fine textured subsoils and are noncalcareous in the surface and upper subsoil. The azonal soils are aeolian and alluvial, moderately coarse and coarse texured and noncalcareous. The wind transported soils have been deposited in linear northeast southwest pattern of low ridges and dunes.

13. Moderately coarse to medium textured, moderately deep to deep soils on the ridges and on long gentle slopes. They are noncalcareous in the surface and in the upper subsoil. Shallow and very shallow residual soils with silted topsoil phases are on the breaks adjacent to the flood plain, and include shale and sandstone escarpments. There are medium to moderately fine textured soils along the narrow floodplain.

14. Deep to very deep, moderately coarse to coarse textured soils. The parent material is re-worked sand and loamy sand from nearby old alluvial deposits. Soils may be calcareous or noncalcareous on the surface but are usually calcareous in the subsoil.

15. Sands and sandy loams are on the low ridges and loamy sands occur along the narrow swales and moderately sloping alluvial fans. In the gently sloping interspersed areas are soils with moderately coarse textured surface soils and medium textured subsoils.

16. Alluvial and colluvial soils of the major drainages.




Map 11. Variation in the degree of erosion in the Little Colorado overview unit.

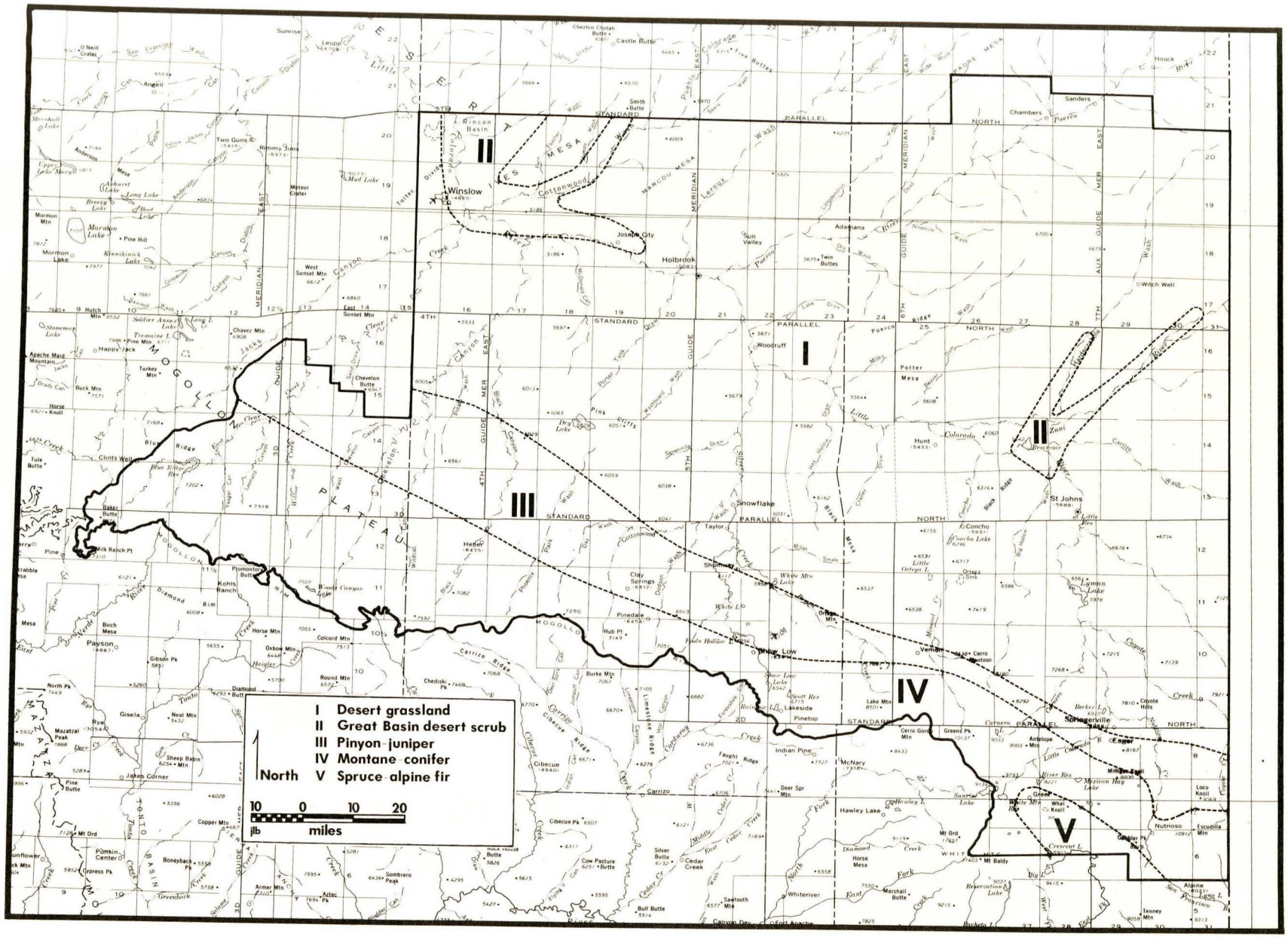

I Desert grassland
II Great Basin desert scrub
III Pinyon-juniper
IV Montane-conifer
V Spruce-alpine fir
North
10 0 10 20
miles
Winslow
Holbrook
Snowflake
Woodruff
St Johns
Springerville
Payson
Pinetop
Show Low
Heber
Pinedale
Clay Springs
Joseph City
Cottonwood
Sanders
Chambers
Houck
Witch Well
Zuni
Concho
Lyman Lake
Becker L.
Crescent L.
Hawley Lake
Indian Pine
Deer Spr Mtn
Mt Ord
Mt Baldy
Whiteriver
Cibecue
Carrizo
Greer
Alpine
Nutrioso
Escudilla Mtn
Tenney Mtn
Fort Apache
Canyon Day
Bull Butte
Saetoon Mtn
Marshall Butte
Reservation Lake
Horse Mesa
Cedar Creek
Silver Butte
Cow Pasture Butte
Sombrero Peak
Aztec Pk
Armer Mtn
Pumkin Center
Boneyback Pk
Cypress Pk
Jakes Corner
Pine Butte
Copper Mtn
Sheep Basin
Gisela
Neal Mtn
Mazatzal Peak
Gibson Pk
Diamond Butte
North Pk
Round Mtn
Chediski Pk
Burke Mtn
Oxbow Mtn
Horse Mtn
Colcord Mtn
Kohls Ranch
Plumontara Butte
Milk Ranch Pt
Baker Butte
Tule Butte
Clints Well
Blue Ridge
Turkey Mtn
Buck Mtn
Horse Knoll
Chevelon Butte
Chavez Mtn
Happy Jack
Pine Mtn
Apache Maid Mountain
Soldier Annex L.
Stonemen Lake
Morman Mtn
Morman Lake
Knnikinick Lake
Pine Hill
Meteor Crater
Two Guns
Rimmy Jims
Rincon Basin
Smith Butte
Castle Butte
Sunrise
O'Neil Crater
Angell
Leupp
Cherhon Chidah Butte
Free Buttes
Houck
Sun Valley
Twin Buttes
Adamana
Potter Mesa
Hunt
Concho Lake
Little Ortega L.
Ortega Mtn
White Mtn Lake
Lake Mtn
Cerro Gordo Mtn
Greens Pk
Antelope Mtn
Coyote Hills
Miller Peak
Merrion Hay Lake
Loco Knoll
Whal Knoll
Sunrise Lake
Lakeside
Scott Res
Limestone Ridge
Carrizo Ridge
Cibecue Ridge
Taught Ridge
Burnt Corral Ridge
Chevelon Canyon
Willow Creek
Clear Creek
Dry Lake
Pinta Canyon
Woodruff Canyon
Pinta Creek
Pinal Mtns
Mogollon Rim
Mogollon Plateau
Colorado Plateau
Little Colorado River
Black River
Salt River
Verde River
Tonto Basin
Tonto Creek
Diamond Creek
Diamond Rim
Canyon Creek
Cibecue Creek
Carrizo Creek
Chevelon Creek
Silver Creek
Show Low Creek
Pinedale Creek
Clear Creek
Willow

Table 4. Plant and animal constituents of the major Communities of the Little Colorado overview unit (After Aitchison and Theroux 1974)

| Biome | DESERT SCRUBLAND | SHORTGRASS GRASSLAND | PINYON-JUNIPER WOODLAND | PONDEROSA PINE FOREST | | PINE-FIR FOREST | | |
|---|---|---|---|---|---|---|---|---|
| Plant Community | | | | Ponderosa Pine | Pine-Bunchgrass Park | Pine-Fir | Mountain Meadow | Fir-Aspen |
| Dominant Vegetation | Shadscale<br>Fourwing Saltbush<br>Dropseed | Blue Grama<br>Galleta<br>Sand Dropseed<br>Fleabane<br>Winterfat<br>Wolfberry<br>Juniper<br>Pinyon | Fringed Sage<br>Rabbit Bush<br>Pinyon<br>One-Seed Juniper<br>Ponderosa Pine<br>Gambel Oak<br>Skunk Bush | Ponderosa Pine<br>Gambel Oak<br>Alligator Juniper<br>Buckbrush<br>Squirrel Tail<br>Lupine<br>Rabbit Brush<br>N. Mex. Locust<br>Mtn. Muhly<br>Arizona Fescue<br>Mutton Grass<br>Golden Pea | Arizona Fescue<br>Mtn. Muhly<br>Pine Dropseed<br>Squirrel Tail<br>Muston Grass<br>Western Yarrow<br>Ponderosa Pine<br>Buckbrush<br>Skunk Bush<br>Gambel Oak<br>Geranium<br>Red & Yellow Pea | Arizona Fescue<br>Ponderosa<br>Douglas Fir<br>Gambel Oak<br>White Fir<br>Oregon Grape | Tufted Hairgrass<br>Timothy<br>Redtop<br>Sedges<br>Rushes<br>Clover<br>Dandelion | Bracken Fern<br>Honeysuckle<br>Douglas Fir<br>Aspen<br>White Fir<br>Strawberry |
| Mammals | Pronghorn<br>Jackrabbit<br>Gray Fox<br>Coyote | Pronghorn<br>Blacktail Jackrabbit<br>Desert Cottontail<br>Gray Fox<br>Coyote | Elk<br>Desert Cottontail<br>Kit Fox<br>Spotted Skunk<br>Deer Mouse<br>Pocket Mouse<br>Kangaroo Rat | Elk<br>Muledeer<br>Abert's & Golden Mantled Squirrel<br>Porcupine<br>Mountain Lion | Elk<br>Muledeer<br>Badger<br>Valley Pocket Gopher<br>Bobcat<br>Coyote | Elk<br>Muledeer<br>Black Bear<br>Least Chipmunk<br>Longtail Weasel<br>Red Squirrel | Elk<br>Pocket Gopher<br>Deermouse<br>Mex. Vole | Elk<br>Black Bear<br>Lion<br>Red Squirrel |
| Birds | | Meadowlark<br>Night Hawk<br>Horned Lark<br>Chestnut Collared Longspur | Lark Sparrow<br>Black Throated Gray Warbler<br>Black-Chinned Sparrow<br>Bush-tit<br>Rock Wren | Turkey<br>Goshawk<br>Mtn. Chickadee<br>Golden Eagle<br>Ruby Crowned Kinglet | Turkey<br>Western Bluebird<br>Chippin Sparrow<br>Lazuli Bunting<br>Pygmy Nuthatch | Western Goshawk<br>Evening Grosbeak<br>Am. Raven<br>Spotted Owl<br>Mtn. Chickadee | Turkey<br>Robin<br>Pine Siskin<br>Slate-colored Junco | Turkey<br>Band Tail Pigeon<br>Am. Raven<br>Stellar's Jay<br>Spotted Owl |

certainly have recovered evidence in one or more of the excavations that has occurred in the area. However, excavations in sites dated before AD 1 are minimal and current excavations do not even approach a continuous series. Thus, it is impossible to be certain that the earliest human occupation of the study area was not affected on one or more occasions by vulcanism.

## Topography

Because of the basic geological stability of the study area, it is unlikely that major topographic patterns have varied during the period of human occupation. Local conditions have, however, probably varied considerably. This variation is likely to have been greatest in areas where erosion, as depicted in Map 11, is greatest. In these areas, there were periods of time in the prehistoric past when erosion was an active process and periods when deposition was an active process (Hevly and Cooley 1964, Bowman 1975).

Neither the number of such events nor the periods of time at which they occurred can be described at present. Given the extreme variability in precipitation and stream flow that has been described, it seems unlikely that there is any good correlation from one drainage to another except at extremes of precipitation. However, one can postulate that there were periods when stream channels were shallow and gentle terrace systems well developed. In other periods channels were deeply entrenched. The extent and stability of dune fields in the area is also likely to have varied considerably over the span of human occupation of the area.

## Precipitation and Temperature

Two lines of evidence inform our understanding of past variation in climatic conditions in the study area: pollen (Schoenwetter 1962, Hevly 1964, Schoenwetter and Dittert 1968, Briuer 1977, Zubrow 1979) and tree-rings (Dean and Robinson 1977). Both indicate that there has been substantial variation in the past. It is not clear, however, that variation during the last 2000 years is beyond what can be described on the basis of current conditions.

The growth of tree-rings reflects moisture and temperature conditions during the preceding 12 months. Dean and Robinson (1977) have used this correlation to generate maps of dendroclimatic variability from AD 680 to 1970. The maps illustrate the climatic conditions that existed during each decade between these years. In general, wider rings are formed during periods that are wet and cool, narrower rings during periods that are warm and dry. For mapping purposes, deviations are expressed in "standard normal units" of departure from mean conditions. Three mapping stations in or immediately adjacent to the study area (W. Puerco, Little Colorado, N. Central Mountains) are used in an effort to understand past variation.

Pertinent information from these stations is shown in Table 5. If readings from the various stations were highly correlated, one would expect an average of zero in the long run. For this reason, the values shown are absolute values. In the average decade, the difference between the station with the widest and the station with the narrowest ring width was 1.67 standard normal units, indicating that, in general, variation in ring formation (inferentially, temperature and precipitation) was substantial. There was also some variation from century to century with the most recent centuries characterized by more variation than was typical of earlier ones. Thus, modern climatic data indicate somewhat more extreme variation than was typical at most points in the past. Equability within the study area has been decreasing since 680 AD.

To understand the tree ring data one may also consider extreme values. Table 6 shows the percentage of years in which at least one station had a value of less than -1 standard normal units and in which values at the other stations were all less than -1, or between -.1 and -1, or between 0 and +1, or above +1. The typical situation that occurred when extremely warm and dry conditions existed at one station was that at least one other station was above or well above average, wetter and cooler than usual.

These data suggest that, through the period of time from AD 680 to the present, there is little point in attempting to describe average conditions over the study area;

Table 5. Mean difference between minimum and maximum tree-ring width values at recording station

| CENTURY | MEAN | STANDARD DEVIATION |
|---|---|---|
| 900-1000 | 1.125 | .835 |
| 1000-1100 | 1.75 | .682 |
| 1100-1200 | 1.9 | .945 |
| 1200-1300 | 1.2 | .627 |
| 1300-1400 | 1.6 | .625 |
| 1400-1500 | --- | --- |
| 1500-1600 | --- | --- |
| 1600-1700 | 1.15 | .935 |
| 1700-1800 | 2.04 | .961 |
| 1800-1900 | 2.05 | .974 |
| 1900-present | 2.17 | 1.29 |

Table 6. Conditions when at least one station in the study area is -1 standard normal unit from the mean

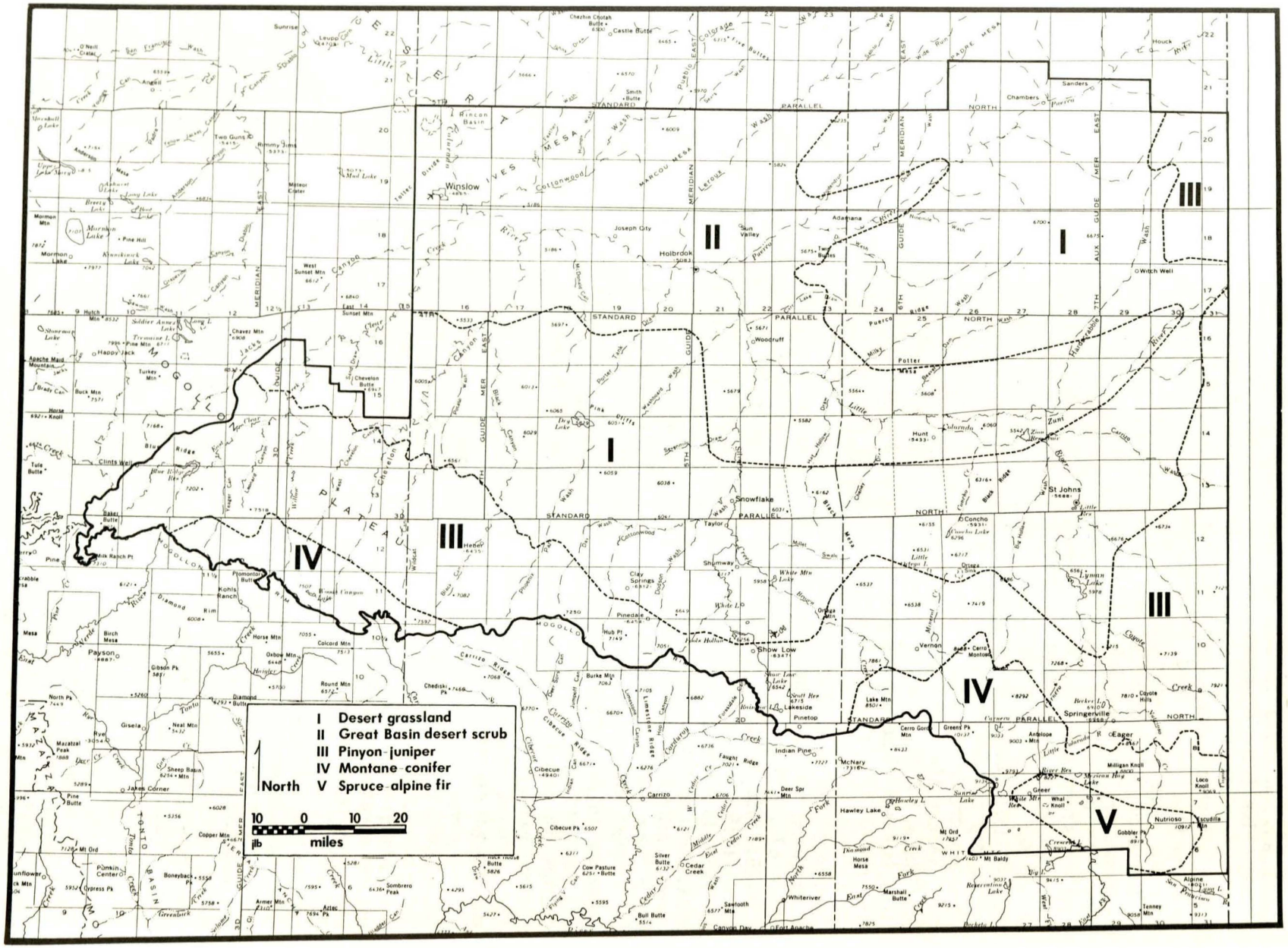
| | |
|---|---|
| ALL BELOW -1 | 3 (8%) |
| AT LEAST ONE STATION BETWEEN -.1 and -1 | 16 (44%) |
| AT LEAST ONE 0 to +1 | 10 (28%) |
| AT LEAST ONE 1+ | 7 (19%) |

what was typical of the area was substantial variability in temperature and precipitation. Since it is unlikely that three observations out of a population of thousands of potential observations would hit loci with high and low extremes, it is probable that conditions were even more varied than these data suggest. Pertinent aspects of the dendroclimatological record will be considered in subsequent discussions of major prehistoric adaptations and events.

The precise interpretation of pollen samples recovered from prehistoric contexts is highly problematical. Any given sample reflects both local and regional environmental conditions. Further, the degree to which one or the other of these is represented depends on the context of deposition; for example, wind causes some pollen grains to be carried much greater distances than others. In addition, when samples are taken from cultural contexts, at least some of the types recovered are the product of human behavior while others are the product of natural processes.

Nevertheless, palynologists have used these data to discuss changes in the seasonality of moisture and in overall effective moisture. Schoenwetter studied pollen samples from a variety of cultural and noncultural loci in the study area (1962). He interpreted the samples in terms of the seasonality of rainfall, opposing heavy summer dominant regimes such as those of the present to times when precipitation was more evenly distributed over the entire year. Conditions similar to those at present occurred between 1400 and 1200 BC, between AD 1000 and 1200, and from AD 1350 to the present. Heavy summer rainfall was also characteristic from AD 1200 to 1350 but with additional evidence indicating local standing water. Light summer rainfall regimes existed at about AD 300 and between AD 350 and 1000.

Hevly (1964) defines four pollen zones for the area. Zone four was characteristic of the last glaciation when conditions were cooler and wetter than at present. Zones II and III, falling between the time of Christ and about 7000 BC, are periods of




Map 13. Extent of major plant communities in the Little Colorado overview unit given a 500 foot depression from current conditions.

In point of fact, modern conditions are probably between the two. Moreover, dendroclimatological data suggest that shifts in temperature and rainfall conditions are of too short a duration to produce such widespread alterations of vegetative patterns. Had temperature and rainfall shifts been of the duration that seemed likely when Hevly made his statement, these extremes might have been reached. However, currently available evidence suggests that greatly reduced variation is expectable and the figures may represent extremes that existed during a relatively few restricted epochs of drastic change.

Bohrer has described another pattern that was characteristic of the area prehistorically (1972). Her analyses indicate that vegetation in the vicinity of what are now deeply entrenched washes once included Typha, Equisetum and other plant species indicative of moist conditions. She infers that during these wetter periods, when downcutting was not occurring, streams were flowing through grassy swales with reeds and cattails growing in the stream channels.

Hevly (n.d.) has also noted the potentially important effect of human activity on the pollen record. He notes, for example (1964), that there is an increase in pine pollen after prehistoric abandonment of the area and before modern lumbering activities begin. He has also observed a generally negative correlation between prehistoric increases in numbers of humans and juniper pollen frequencies. As humans begin to increase in numbers at about AD 900, juniper pollen began to decline and increased again at about AD 1200 when the abandonment of the area by humans began. Apparently, the use of juniper for construction and for fuel had a sufficiently drastic effect on the abundance of the species that the prehistoric pollen rain was altered. Pinyon pollen on the other hand, varies in a manner quite different from juniper, in close correlation with changes in effective moisture. Probably because prehistoric humans would have been less likely to use this important food tree for construction or fuel, variation in this pollen type reflects variation in natural conditions.

## FUTURE RESEARCH

The preceding summary represents the result of surveying a great diversity of environmental information, none of which was prepared specifically for the purpose of understanding the overview area. While I believe these data represent the best possible description of environmental conditions, much remains to be known. While it is reasonable to believe that pertinent studies will be done concerning some topics, there are others where new information is less likely.

A variety of the management activities undertaken by the Forest Service and the Bureau of Land Management contribute directly to understanding environmental conditions in the overview area. Specifically, timber, range, soil, hydrological and mineral studies contribute directly to archeologists' ability to reconstruct past environments. There is no need that such studies be undertaken for the direct purpose of pursuing better understanding of cultural resources. However, it is imperative that cultural resource managers be kept informed of on-going environmental studies. Slight modifications of project designs may make their product more useful to cultural resource managers and other archeologists. Similarly, it is essential that these same individuals be kept aware of the results of major new studies so that these can be used in improving the information presented here.

The reconstruction of past environments goes well beyond information resulting from land-managing activities. A variety of specific studies would help to improve understanding of prehistoric events within the study area.

1. Existing information concerning glaciation in the area is suggestive rather than definitive. Familiarity with glacial land forms would be desirable for archeologists conducting surveys at high altitudes within the study area. One might then expect that our understanding of glaciation would grow. Control of this topic is important both to our understanding of high altitude adaptations in the area and because glaciation is correlated with climatic changes that occur at other altitudes.

2. Geomorphology in the overview unit is poorly understood at present. To date, archeologists working in the area have not elected to employ geologists or geographers to provide an understanding of paleosols or deposition/erosion sequences. Greater

understanding of these phenomena would increase our knowledge of the conditions under which prehistoric peoples lived.

While it is possible that this knowledge will accumulate as the result of limited geomorphological studies done in conjunction with specific projects, the rate at which such studies have been done in the past does not give one great hope.

Similarly, the extreme hydrological variation within the study area suggests that the results of a single drainage study cannot be generalized. Thus, our understanding of the environment in which prehistoric peoples lived will be most greatly improved as the result of a regional study, if such can be arranged.

3. There are currently only three tree-ring stations within the study area.

Clearly, our understanding of variation in temperature and precipitation will be greatly increased if more stations are developed. Most archeologists are aware of the importance of tree-ring dating, but are unaware that the majority of tree-ring samples recovered in the study area cannot be dated. This problem increases the need to see that all possible samples are sent to the Laboratory of Tree-Ring Research.

4. Palynological studies provide information concerning climate and vegetation patterns. A large quantity of pertinent material has been taken from the overview unit. However, no single synthesis of these materials exists at present. It would be useful to arrange for a study that focuses specifically on the study area. In the context of such a study, an effort to resolve some of the interpretive problems that currently beset palynology, e.g., the effects of cultural as opposed to natural factors (such as wind) should be undertaken. In the meantime balancing the effect of these forces is impossible and the reconstruction of prehistoric climates correspondingly difficult.

# RESOURCE ACQUISITION

## INTRODUCTION

The natural environmental characteristics of the Little Colorado Inventory Unit have been described above. In this chapter, those same characteristics are again considered, but from the perspective of the prehistoric people whose survival was dependent on their ability to harness the resources and overcome the environmental difficulties of the area. No human population uses all of the resources of the area in which it exists; some potentially useful resources are simply not identified as such. Similarly, not every environmental variable is relevant to the ability of the group to survive in an area. What may be critical for one group with one subsistence strategy may be quite irrelevant for another. Even with the subsistence strategy as a constant, human population size has a crucial effect on the extent to which any given natural variable poses a limit for a particular group.

Both subsistence strategies and size of human populations varied drastically during the prehistoric occupations of the study area. While there is little concrete evidence that informs our understanding of local patterns, PaleoIndian peoples are generally assumed to have been "big-game hunters." While this characterization overemphasizes the importance of big game in the diet of most such groups, there is greater evidence of the use of large fauna during the PaleoIndian stage than in any succeeding ones. Similarly, Desert Culture peoples are generally believed to have been hunters and gatherers, lacking the degree of dependence on agriculture characteristic of later groups. While the inhabitants of the Southwest after the time of Christ have generally been viewed as agriculturalists, growing evidence suggests that the temporal relationship of hunter-gatherers and agriculturalists is less clearly delineated than past reconstructions suggest.

For this reason, I have chosen not to describe the strategies that the prehistoric residents of the study area used in modal patterns. The following discussion will instead emphasize particular patterns of resource utilization for which good evidence exists. To the extent that these appear to be characteristic of particular periods or areas, these limitations will be noted.

## GEOLOGICAL RESOURCES

In most areas, geological resources are useful as raw materials for manufacturing artifacts and buildings. The sole exception to this principle is the use of naturally sheltered loci such as caves as dwelling units. In the study area, the contact between the Coconino Sandstone and the Kaibab Limestone is an example. Where this contact is exposed, usually in relatively deep canyons in the western quarter of the study area, erosion has created caves and rock shelters that served as both temporary and permanent dwelling places.

The Coconino Sandstone is relatively soft. It was probably a major source of tempering material for ceramic manufacture. Slabs cut from the sandstone were also used as deflectors. The Kaibab Limestone and the Moenkopi, Mesa Verde, and Dakota Sandstones were frequently used as a building material after about AD 900. In some cases the materials were used in the form of natural blocks, while in others raw sandstone was shaped.

Some facies of the Moenkopi Sandstone are sufficiently soft that, when wetted, they can be turned into a coarse plaster. They were used as such by inhabitants of the area after the time of Christ. Travertine deposits occuring as hills or hill caps in the vicinity of St. Johns appear to have been similarly used by both prehistoric and early modern occupants of the area (Sirrine 1955).

All of the previously mentioned sandstones, the Kaibab Limestone and local basalts were used to make mortars, pallettes, metates, and manos. Quartzite cobbles derived from the Rim Gravels were also used as manos, hammerstones, and pestles.

Minerals found in the various geological formations were used by prehistoric peoples in manufacturing chipped stone tools. The Rim Gravels were a source of quartzite, cherts, chalcedonies, and a variety of igneous rocks. Basalts sometimes achieved sufficient hardness to be used by prehis-

toric peoples. The Datil Formation is a source of sandstone, siltstone, rhoyolite, latite, andesite, basalt, quartzite, jasper, quartz, granite gneiss, schist, and other minerals in conglomerate lenses. Siltstone occurs in the Mancos and Mesa Verde Formations. Quartzite and chert pebbles are derived from the Mesa Verde Formation. Chinle deposits are a source of cherty limestone, siltstone, mudstone, quartzite pebbles and especially petrified wood. The Kaibab Limestone yields a highly calcareous chert. Mudstone, siltstone, chalcedonies, and cherts can be recovered from the Moenkopi Formation and derived sediments. In addition, some alluvial deposits derived from these, especially along major river valleys, are characterized by extensive zones of desert pavement containing many nodules of sufficient size to be used in chipped stone tool manufacture. This is not to argue that all chipped stone tools were made of local materials. Imported resources will be discussed in a later section.

As noted earlier, halite, copper, and manganese are present in the study area. There is no clear evidence that any of these were extensively used by either prehistoric or modern peoples. They were used as pigments or in the case of halite as a condiment by prehistoric peoples.

Clays are abundant in the area, although especially pure clays and some kaolins are associated with the Chinle Formation and sediments derived from it. These were used by prehistoric peoples in manufacturing ceramic vessels. Sands and river sediments were used as tempering material.

In prehistoric North America, corn is almost never used as an important subsistence resource unless a technology involving soaking it in a basic solution is present (Katz et al., 1971). Halite and alkali deposits may have been used for this purpose, although the use of wood ash is more likely.

## LANDFORMS

Since all of the earth's surface is a landform of some variety, every cultural resource locus occurs on a landform. Nevertheless, there are a number of situations that seemed to have represented especially desirable loci for the activities of prehistoric peoples.

Many early villages are located on promontories, often basalt-capped mesas overlooking broad alluvial valleys. These locations may have been valued because they provided a view of game movements through the area, or information on the movement of non-local peoples into the area. Some such promontories are also frequent loci of very late prehistoric settlements, sometimes enclosed by walls. Apparently, these were defensive locations.

Terraces immediately above floodplains were a favored dwelling location of most prehistoric and early modern agricultural peoples. The floodplains themselves were a frequent field location. The slope of the land surface has an important general effect on the ability of prehistoric peoples to use an area for intensive agriculture. Irrigation, gridding, and terracing are possible only on gently sloped land. The strategies can be used on slopes with increasingly steeper grades in the order listed above (Plog and Garrett 1972). Because of the high porosity of sand, dune fields are a favored agricultural locus for the Hopi. It is likely that the same was true in prehistoric times.

Volcanic necks and high mountain peaks are often the location of prehistoric or ethnohistoric shrines. The more visible of these were undoubtedly also important in defining transportation routes through the area.

## TEMPERATURE AND PRECIPITATION

Temperature and precipitation are important resources for any agricultural people. Unfortunately, the two are negatively correlated in the study area: the greatest precipitation occurs at the highest elevations and the greatest number of frost-free days at the lowest. This problem was overcome through at least three discrete behavior patterns. First, some prehistoric and early modern populations settled at the intermediate elevations where neither precipitation nor temperature conditions were ideal but were at least tolerable.

Second, some groups solved the problem by planting crops in a number of different loci, not in the expectation that all fields would yield a harvest in a given year but only in the expectation that some would. In a cool, wet summer, there was

insufficient growing time at high altitudes, but adequate moisture was obtained in areas where the growing season was sufficient. In a warm dry year, precipitation was inadequate at lower elevations, but the growing season was sufficient and precipitation was adequate at higher elevations. This practice is common among the Hopi, who plant fields over a 40-mile linear distance with nearly 2000 feet of altitudinal variation.

A final strategy was more or less formalized exchange relationships among groups occupying highland as opposed to lowland areas. The crops of the two areas did not always succeed in the same year, and resources were transferred to offset deficiencies in one area when they were abundant in the other. This practice was characteristic of early modern peoples in the area (Lightfoot 1979) and may have been typical of some prehistoric peoples also.

## SOIL

Good soil is an important resource for agricultural peoples. Modern hybrid corn, the most important and demanding of the local crops, generally requires a minimum soil depth of about ten inches. It does best when pH values are between 6.0 and 7.0. Soils with these characteristics are quite limited within the study area. Of the soil types described earlier, only types two, three, and six meet these conditions. Unfortunately, deposits of these soils are all at the highest elevations where growing seasons are marginal. The deeper alluvial soils at low elevations, where the growing season is long, have generally high pH values.

Of course, these figures are generated specifically for the case of modern corn. Hopi fields have pH values between 8.0 and 8.5 (Bradfield 1968), suggesting that Hopi corns may be specifically adapted to greater alkalinity. It is known that the Hopi have maintained strains of corn specifically adapted to particular climatic and environmental extremes (Whiting 1934, 1937; Plog 1978b). So, it is not unlikely that some or all of the native strains may be more tolerant of pH conditions unfavorable for modern corn.

If this factor is set aside, there are soils capable of sustaining corn agriculture throughout the study area, although soil depth is a significant problem in the zones covered by soil types one, three, five, six, and ten. In general, the distribution of the best agricultural land is quite patchy. Prehistoric sites, in contrast with modern ones, rarely occur on top of, but rather adjacent to, the best agricultural soils.

## FLORA

During the prehistoric, historic, and modern utilization of the study area, most of the floral resources have been used for one purpose or another. A compendium of the uses to which particular resources were put would be as long as this study itself is intended to be. Moreover, it would be highly problematical. While there are some relatively clear associations between particular plants and use patterns (e.g., medicines) there are other uses that can be fulfilled with a variety of different resources. There are, for example, literally hundreds of plants that could be used to make a brush or a broom and dozens from which baskets could be made. While the ethnobotanical literature ascribes particular uses to resources, it is dubious that, over the centuries this report covers, there was much constancy in the use of particular floral resources for particular tasks. There are three areas in which the use of those resources is particularly important to understanding human use of the area, construction, subsistence, and fuel.

Spruce, fir, ponderosa, juniper, and pinyon are all suitable construction materials. In recent times, ponderosa and fir have been the most important. This selectivity reflects two factors: (1) the size and shape of the trees allows cutting a large number of relatively standardized pieces; and (2) the modern road system facilitates movement of trees from their cutting to their use loci. Prehistorically, juniper appears to have been the most important resource utilized in most of the study area. There are several reasons for this changed behavior. First, prehistoric dwelling places were much smaller. As a result, neither size nor standardization of beams and boards were as important as they are today. Also, prehistoric technologies were less suitable for harvesting large trees. Second, prehistoric peoples lacked the ability to move large quantities of lumber from the acquisition site to the use

site. Pinyon was probably not a preferred building material prehistorically because of its importance as a food source.

Commonly used native food plants are listed in Table 7. These resources are based on ethnobotanical studies among the Hopi (Whiting 1939), Navaho (Elmore 1944) and various groups living immediately below the Mogollon Rim (Gallagher 1977). References to the parts of each plant utilized are from these sources. References to the season of availability at elevations at which the resource can be found are from Kearney and Peebles (1960), although I have modified some estimates to reflect my own perceptions of plant distributions.

It is apparent that a great variety of resources are available in the study area, most below about 8000 feet. Some resources are available during all seasons except winter. Potentially, all of the resources mentioned can be stored in one fashion or another, although nuts and grains are generally more storable than greens and some grains are more easily dried than others.

In Table 8 various nutritional aspects of selected resources are given. Corn (Zea) and beans (Phaseolus) are included in the table for comparative purposes. These data are based on tables in Hoffman (1974) and Gallagher (1977). The nutritional qualities of natural resources are clearly sufficient for a well balanced diet, even excluding the many natural resources for which appropriate data are unavailable.

Any of the woody plants available in the study area could have been used for fuels, as could grasses. The most efficient fuel resources are, and were, those that concentrate combustible materials. Pine, juniper, and pinyon would probably have been the preferred fuel sources, although the size of ponderosa relative to the then extant technology would have resulted in small trees or dead wood of this type being utilized. While oak is not abundant, it may have been valued for smelting and other activities requiring a high temperature.

## FAUNA

A variety of the animals found in the study area represent potentially important food resources. The most important of these are desert cottontail (Sylvilagus audobonii), jackrabbitt (Lepus californicus), beaver (Castor canadensis), black bear (Ursus americanus), raccoon (Procyon lotor), javelina (Tayassu tajacu) elk (Cervus canadensis), mule deer (Dama hemionus), white-tailed deer (Dama virginiana) prong-horn (Antilocarpa americana), and turkey (Meleagris gallopavo). In addition, seasonal wildfowl may have represented important resources along the major river and streams and around the playas. The Little Colorado Spinedace (Lepidoma vittata), Bluehead Mountain Sucker (Pantosteus discobolus), and speckled dace (Rhinichthys osculus) now occur in permanent streams. Native brown trout and a variety of other fishes may have inhabited the streams and rivers when they were more permanent.

There are many other small mammals and birds that may have been eaten by prehistoric peoples. Faunal work in the area is miminal at present, and conditions of bone preservation are not good. Therefore, one must assume that if smaller animals were eaten, little evidence has survived to the present. Weight and meat yields for some of the more important animals mentioned above are shown in Table 9.

## STRATEGIES OF RESOURCE UTILIZATION: FOOD

The discussion to this point has emphasized available resources and broad patterns of utilization. The use of geological resources in construction and for artifact manufacture will be discussed subsequently. The issue of utilizing locally available materials, as opposed to their exchange, will also be considered later. Two strategies of resource utilization will be addressed here: the collection and production of foodstuffs and the acquisition of fuel.

The two major strategies used in procuring foodstuffs were hunting and gathering and agriculture. There is no question that food production, agriculture, is the later of the strategies. However, the precise point at which the shift to agriculture occurs, and the extent to which prehistoric peoples relied on this strategy, remain important questions. In general, the earliest suggestive evidence of domesticates in the Southwest dates to between

Table 7. Commonly used food plants

| NAME | COMMON NAME | PART USED | SEASON | ELEVATION (Feet) |
|---|---|---|---|---|
| Pinus edulis | Pinyon | nut | Fall | 6000-7500 |
| Juniperus sp. | Juniper | berries | Fall | 6000-8000 |
| Typha | Cattail | stem, head | | -8000 |
| Sporobolus sp. | Alkali-sacation, dropseed | seed | June-October | -6000 |
| Oryzopis humenoides | Indian rice grass | seed | June-August | -8000 |
| Scirpus | Bullrush | stalk | | -9000 |
| Tradescantia sp. | Spiderwort | greens | Spring | |
| | | root | August-September | -9500 |
| Allium sp. | Wild Onion | bulbs | April-August | -9000 |
| Calochortus sp. | Mariposa, Sego Lily | bulb | Aprin-June | -8000 |
| Yucca sp. | Yucca | root, bud | April-July | -8000 |
| Juglans Major | Walnut | Nut | Fall | -700 |
| Quercus sp. | Oak | Nut | Fall | -800 |
| Celtis reticulata | Hackberry | berry | Summer | -6000 |
| Morus microphylla | Mulberry | berry | Summer | -6000 |
| Humulus americanus | Hop | yeast | | -9500 |
| Urtica sp. | Nettle | greens | Spring | -9000 |
| Phoradendron sp. | Mistletoe | berries | | -7000 |
| Eriogonum sp. | Buckwheat | root | March-April | -9000 |
| Rumex sp. | Dock | stems, leaves | March-April | -6000 |
| Chenopodium | Lambs quarter | leaves | Spring | -9000 |
| | | seeds | Summer | |
| Amaranths | Amaranth | leaves | Spring | -8000 |
| | | seeds | Summer | |
| Acanthochiton wrightii | | leaves | Summer | -6000 |
| Portulaca oleracea | Purslance | seeds | Late Summer | -8500 |
| Stanleya sp. | Desert Plume | leaves | May-September | -6000 |
| Descuriana sp. | Tansy mustard | leaves | | -7000 |
| Cleome serrulata | Beeweed | leaves | Spring | -8000 |
| Wizlenia melilotoides | Jackass clover | leaves | Spring | -6000 |
| Ribes sp. | Current, goose berry | berries | March-June | -10,000 |
| Amelanchier sp. | Service berry | berry | April-June | |
| Rubus sp. | Raspberry | berry | May-September | -9000 |
| Fragraria sp. | Strawberry | berry | May-September | -11,000 |
| Rosa arizonica | Rose | fruit | | -8000 |
| Astragalus ceramicus imperfectus | Milkweed | root | Spring | -7000 |
| Rhus trilobata | Squawbush | seeds, berries | | -7500 |
| Vitis arizonica | Grape | berry | Fall | -7500 |
| Mentselia sp. | Stickleaf | seeds | | -7000 |
| Echinocereus sp. | Hedgehog | fruit, flesh | Spring | -8000 |
| Mammilaria sp. | Pincushion | flesh | | -8000 |
| Neomammilaria sp. | Fishhook | | | |
| Opuntia sp. | Prickly pear, cholla | fruit, flesh | | -6000 |
| Cymopterus | Wild celery | leaves, root | | |
| (there are possibly other carrot and celery-like plants utilized) | | | | |
| Actostaphylos uva ursi and | Bearberry | berries | | -8000 |
| pungens | Manzanita | berries | | -8000 |
| Convovulvus arvensis | Bindweed | root | | -7000 |
| Ipomoea e batata | Morning glory | root | | |
| Monarda menthaefolia | Beebalm | leaves | | -8000 |

Table 7 (continued)

| | | | | |
|---|---|---|---|---|
| Chamaesaracha Coronopus | | berries | | -7500 |
| Physalis fendleri | Ground cherry | berries | Summer | -7500 |
| Solanum Jamesii | Wild potato | tuber | July-September | -8500 |
| Sambucus sp. | Elderberry | berries | June-July | 7500+ |
| Helianthus annus | Sunflower | seeds | March-October | -7000 |
| Artemisia sp. | Wormwood, sage | greens, seeds | | -9000 |
| Pectis angustifolica | Marigold | greens | August-September | -7000 |

Table 8. Nutritional characteristics of some commonly used food plants per 100 grams (Gallagher 1976)

| PLANT | CALORIES | PROTEIN (grams) | CARBOHYDRATE (grams) | CALCIUM (milligram) | IRON (milligram) |
|---|---|---|---|---|---|
| Allium | 38 | 1.5 | 8.7 | 27 | 0.5 |
| Amaranth (seed) | | 14.6 | | | |
| Amaranth (raw) | 36 | 3.5 | 6.5 | 2.7 | 3.- |
| Chenopodium | 43 | 4.2 | 7.3 | 3.1 | 1.2 |
| Descurainia | 31 | 3.0 | 5.6 | 1.8 | 3.0 |
| Fragraria | 37 | 0.7 | 8.4 | 21 | 1.0 |
| Helianthus | | | | | |
| seed | 560 | 24.0 | 19.9 | 120 | 7.1 |
| flour | 339 | 45.2 | 37.7 | 348 | 13.2 |
| Juglans* | 628 | 20.5 | 14.8 | - | 6.0 |
| Opuntia | 42 | 0.5 | 10.9 | 20 | 0.3 |
| Phaseolus | 53 | 1.9 | 11.2 | 9 | 1.0 |
| Pinyon | 635 | 13.0 | 20.5 | 12 | 5.2 |
| Prunus | 58 | 1.2 | 14.3 | 22 | 0.4 |
| Quercus | | 10.4 | | | |
| Sambucus | 72 | 2.6 | 16.4 | 38 | 1.6 |
| Solanum | 76 | 2.1 | 17.1 | 7 | 0.6 |
| Portulaca | 21 | 1.7 | 3.9 | 103 | 3.5 |
| Ribes | 50 | 1.4 | 12.1 | 32 | 1.0 |
| Rubus | 73 | 1.5 | 13.6 | 22 | 0.9 |
| Rumex | 28 | 2.1 | 5.6 | 66 | 1.6 |
| Vitis | 69 | 1.3 | 15.7 | 16 | 0.4 |
| Yucca | 403 | 1.2 | 93.0 | 0.2 | |
| Zea | 348 | 8.9 | 72.2 | 22 | 2.1 |
| Phaseolus | 340 | 22.3 | 61.3 | 144 | 7.8 |
| Cucurbita | | | | | |
| Summer | 19 | 1.1 | 4.2 | 28 | 0.4 |
| Winter | 50 | 1.4 | 1.4 | 22 | 0.6 |

Table 9. Meat yields of associated food animals (Gallagher 1976)

| NAME | WEIGHT (pounds) | YIELD (%) |
|---|---|---|
| Castor canadensis | 50 | 70 |
| Cervus canadensis | 600 | 50 |
| Lepus americanus | 4.5 | 70 |
| Odocileus virginianus | 175 | 50 |
| Sylvilagus | 2.8 | 70 |
| Ursus americanus | 300 | 70 |

AD 1000. Lightfoot (1978c) has developed similar evidence for the Springerville area.

## STRATEGIES OF RESOURCE UTILIZATION: FUEL

The published literature concerning Southwestern archeology gives no attention to the fuel requirements of prehistoric peoples. While there are exceptions (Sanders 1976; Miller 1980), the situation is much the same in other parts of the world. Yet, it would be naive to assume that fuel requirements were never a problem in prehistory.

To take the Colorado Plateaus as an example, portions of the area are virtually devoid of major fuel sources. Certainly, one can use sage, saltbush, chamiso and even grasses for fuel, but the efficiency of these sources is limited because of the small sizes of the twigs from such plants. Even given a dense ground cover, available fuel does not approximate that of a woodland or forest zone.

Pine forests present a different problem: fuel is readily available, but in packages that are difficult to manage. In these environments, one would suspect that younger and smaller, rather than older and larger, trees were harvested along with dead wood. In the overview unit the optimal zone for obtaining fuel is the woodland (pinyon-juniper, juniper-pinyon) zone. Individual trees are of a more manageable size, large branches occur closer to the ground, and deadwood is available.

In an effort to assess the potential role of fuel problems in the study area the woodland zone was chosen as a focus. This choice is logical for a number of reasons. First, it appears to be the most densely occupied environment in much of the northern southwest. Second, modern records concerning the woodland have been generated by the Forest Service. Finally, for the reasons discussed in the preceding paragraph, it would seem to represent an optimal situation in regard to the availability of fuelwood; any problems it presents would likely be greater in other environments.

Essential to an evaluation of fuelwood problems are (1) an estimate of availability of fuelwood and (2) an estimate of the rate of utilization of fuelwood. In both instances it is necessary to assume the equivalency of the present and the past, with any differences between the two a potential source of difficulty in respect to the conclusions reached. In some parts of the Southwest, the Forest Service has been involved in estimating the availability of fuelwood for use by modern peoples. I obtained data for the Heber District of the Apache-Sitgreaves National Forest (Hart and Caskey, personal communication). Because only a few plots have been studied and because, as elsewhere in the northern Southwest, there is substantial variation in fuelwood densities with altitude, the mean figure of 3.4 cords per acre is not tight. For this reason the high (5.5 cords per acre) and low (2.7 cords per acre) density will also be used in the subsequent discussion. It seems unlikely that prehistoric figures would have been substantially different from these. Paleoenvironmental reconstructions have generally suggested changes in the boundaries between particular plant communities rather than changes in the density of plants in them.

Data on fuelwood consumption are far more difficult to obtain. Fortunately, Russell (n.d.) recorded the rate of consumption of seven households on the Navaho reservation. The data were recorded in "pickup-trucks-full," a rough equivalent of one cord of wood. Coal was also used by the households in question. While I suspect that because coal is a more efficient fuel, a truckful of coal is more than the equivalent of one cord of wood, I have used an identity between the two. (The maximum number of truckloads of coal used by any household was three out of a total of 13 truckloads of fuel.) Given the small sample size, variation is again high. Mean per capita utilization was 2.7 cords per year with a low of 1.33 cords per capita and a high of 5.33 cords.

The utility of the Navaho as an analog to prehistoric Southwesterners is, of course subject to question. Undeniably, prehistoric peoples could have been more conservative in their use of fuel. At the same time, they used fuel for ceramic manufacturing, which the Navaho do not, and lacked the more efficient stoves employed by the Navaho. Thus, it seems probable that the range of utilization rates should overlap even if a precise figure cannot be esta-

blished. For these reasons, I feel comfortable in using the figures for relatively gross projections.

Tables 10 through 12 illustrate overall rates of utilization for populations of different sizes. One might conceive of the population figures as representing either the population of a single site or the population density/square mile. The "low" figures assume a low per capita rate of utilization and high availability of wood. The "high" figures use a high rate of utilization and low availability of wood and the average figures use average values for both.

The preceding Tables illustrate use rates per year and per generation, which is assumed to average 30 years. The column labelled "site radius/generation" indicates the radius of the zone around a site of a given population that would have been utilized in a generation. A final issue is the time required for the regeneration of the forest. An average value of 100 years is assumed. Thus, the figure indicates the distance that people living in a site of a given size would have to go to obtain wood before the nearby forest was completely regenerated. Of course, some regeneration would have occured in the interim. But, to the extent that less than fully regenerated stands were used, the overall rate of regeneration was decreased and the wood that could be obtained was smaller and less efficient as fuel.

A number of conclusions can be reached using these data. First, consider the average situation. After only a single generation, the inhabitants of a site in a region where sites housing 100 or more individuals occurred at a density of one per square mile (or the inhabitants of a region with an average density of 100 per square mile) would have begun to impinge on each other's resouces. If sites with 50 inhabitants occurred at a density of one per square mile in a region (or if average density in a region was 50 per square mile) the ability of a woodland to regenerate itself would have been taxed after a century. I do not wish to argue that average site density over the study area was ever this high. Equally clearly, there were times and places when it was.

Given the worst case (high consumption and low availability), a population density of 50 per square mile (or an equivalent average site size) would have produced a problem within a generation. An average density of 11 people per square mile would have been sufficient to tax the ability of a woodland to regenerate itself. An average density such as the latter is not unreasonable for the overview area.

Given the best case (low consumption, high availability), only a region with a population density of 500 per square mile or greater, or one in which sites with a population of 500 occurred in the average square mile, would have experienced difficulty after a single generation. The ability of the forest to regenerate itself, however, would have been taxed with high population density or average site sizes of 100 people.

Three implications of this simple simulation are clear:

(1) Under any conditions, sites housing 1000 or more people would have had fuel wood requirements that would have impinged on nearby peoples, unless a minimum radius of 5 miles and an average radius of a little over six miles around the site was unoccupied. The latter situation, I suspect, rarely occurred. Thus, some means of allocating/conserving fuelwood was almost certainly necessary once sites of this size began to occur in particular regions. To the extent that sites had more than 1000 individuals, the problem would have become increasingly greater.

(2) In any other than the most optimal environments, pressure to begin conserving fuelwood, or measures to allocate the resource equitably, or to move to new areas were fuelwood was more abundant, would have been felt within a generation in places where population density exceeded 100 per square mile. These pressures would have been felt within a few generations if population density exceeded about 25 per square mile.

(3) In less than optimal environments, or among peoples with less conservative practices, these pressures would have been felt sooner or with lower population densities.

There are many flaws in these data. Yet, even granting substantial variation, it is clear that fuelwood could have been a resource limiting the ability of prehis-

Table 10. Rates of fuelwood utilization using mean figures for fuelwood availability and consumption (3.4 cords/acre - 2.7 cords per capita)

| NUMBER OF PEOPLE | ACRES/YEAR | ACRES/GENERATION | SITE RADIUS/ GENERATION (miles) | SITE RADIUS BEFORE REFORESTATION (miles) |
|---|---|---|---|---|
| 5 | 4.00 | 120 | .24 | .45 |
| 10 | 7.90 | 237 | .34 | .63 |
| 20 | 15.90 | 477 | .49 | .89 |
| 50 | 40.00 | 1,200 | .77 | 1.40 |
| 100 | 79.00 | 2,370 | 1.09 | 1.98 |
| 200 | 159.00 | 4,770 | 1.54 | 2.81 |
| 500 | 400.00 | 12,000 | 2.44 | 4.46 |
| 1000 | 790.00 | 23,700 | 3.43 | 6.27 |
| 2000 | 1590.00 | 47,700 | 4.90 | 8.89 |
| 5000 | 4000.00 | 120,000 | 7.72 | 14.10 |

Table 11. Low fuelwood utilization rates based on high availability and low consumption (5.5 cords/acres - 1.3 cords per capita)

| NUMBER OF PEOPLE | ACRES/YEAR | ACRES/GENERATION | SITE RADIUS/ GENERATION (miles) | SITE RADIUS BEFORE REFORESTATION (miles) |
|---|---|---|---|---|
| 5 | 1.20 | 36 | .13 | .24 |
| 10 | 2.40 | 72 | .19 | .35 |
| 20 | 4.80 | 144 | .27 | .49 |
| 50 | 12.00 | 360 | .42 | .77 |
| 100 | 24.00 | 720 | .60 | 1.09 |
| 200 | 48.00 | 1,440 | .85 | 1.55 |
| 500 | 120.00 | 3,600 | 1.34 | 2.44 |
| 1000 | 240.00 | 7,200 | 1.89 | 3.46 |
| 2000 | 480.00 | 14,400 | 2.68 | 4.89 |
| 5000 | 1200.00 | 36,000 | 4.23 | 7.73 |

Table 12. High fuelwood utilization rates based on low availability and high consumption (2.7 cords/acre - 5.33 cords per capita)

| NUMBER OF PEOPLE | ACRES/YEAR | ACRES/GENERATION | SITE RADIUS/ GENERATION (miles) | BEFORE REFORESTATION (miles) |
|---|---|---|---|---|
| 5 | 9.90 | 297 | .38 | .70 |
| 10 | 19.70 | 591 | .54 | .98 |
| 20 | 39.50 | 1,185 | .77 | 1.40 |
| 50 | 99.00 | 2,970 | 1.22 | 2.22 |
| 100 | 197.00 | 5,910 | 1.71 | 3.13 |
| 200 | 395.00 | 11,850 | 2.43 | 4.43 |
| 500 | 999.00 | 29,700 | 3.84 | 7.04 |
| 1000 | 1970.00 | 59,100 | 5.42 | 9.90 |
| 2000 | 3950.00 | 118,500 | 7.68 | 14.02 |
| 5000 | 9999.00 | 297,000 | 12.15 | 22.30 |

toric Southwestern peoples to survive and expand. There clearly were sites and regions where density values as great or greater than those I have used and where fuelwood availability is equal to or less than that we have postulated. Both ethnographic and archeological research sensitive to this issue are essential.

## FUTURE RESEARCH

There is no aspect of the preceding discussion that cannot be informed by more research and more detailed research. Beyond a probably incomplete list of specific resources utilized, it is possible to say little about resource utilization in the area that is more than inspired guesswork based on ethnographic analogy or ethnographic models. The collection of more floral and faunal data is clearly imperative. One potential source of such information is cave deposits where preservation is generally good. Data from these loci must be treated with caution since they may have been special-use sites, as Schemenas' argument concerning green corn suggests. Similarly, Briuer (1975) has noted the great difficulty one encounters in attempting to separate natural from cultural materials at these sites.

Ultimately, more substantial efforts to recover floral and faunal remains during routine excavations of open air sites will solve the problems caused by the current dearth of information. The routine flotation of some sediments will be necessary. Even when only charcoal is recovered, the results can help to provide an empirical basis for evaluating the likelihood that prehistoric peoples in the area actually faced fuelwood crises. Further studies of the differential preservation of floral and faunal materials in localities with different soils will also increase understanding of the areas in which efforts to obtain large floral and faunal samples are likely to be most profitable.

# HISTORY OF RESEARCH

Research within the Little Colorado area began in the late 1800s. By current standards, the records generated by the earliest work are poor. In the case of surveys, one can determine what sites were found and obtain a very rough idea of their location. It is close to impossible, however, to determine which areas were investigated and which were not. Early reports of excavation generally indicate only the site at which work was done. Only museum quality pieces were saved and, even for these, provenience information is no more specific than an indication of the site from which they were taken.

While the quality of work improved over time, there are still problems even during the last two decades. Survey was rarely done with the detailed inspection of the ground surface that is now current and it is generally impossible to even assess the average level of intensity of particular projects. Similarly, while provenience data are more precisely maintained in the case of excavation, tabular summaries of excavated materials are not common.

These comments are not intended as criticism of the individuals responsible for particular projects. To assess the diversity of work that has been conducted in an area against some single standard of recording and reporting would be unfair. However, it is important to any attempted interpretations of prehistory within the overview area that the diversity of standards and techniques employed in data recoverey and reporting be clearly understood.

The first systematic archeological field research in the area was that done by Bandelier in the early 1880s (Bandelier 1890). Bandelier does note some earlier work by Cushing, but no records of this work have been found. Bandelier's own efforts centered on the St. Johns area. He notes the presence of pueblo sites between Zuni and St. Johns and in the Little Colorado River Valley between St. Johns and Springerville. In general, site descriptions are brief. Similarly, his descriptions of the locations of some of the sites do not correspond to cultural and natural features with which he identifies them. One important aspect of his research was the identification of prehistoric irrigation channels in the Little Colorado River Valley.

In 1897, Jesse Walter Fewkes began work in the overview unit as a part of his effort to trace Hopi migration myths. Initially he visited and did limited excavation at Kintiel (Pueblo Grande, Wide Ruin), Pinedale, and Four Mile (Fewkes 1898). Subsequently, he excavated at the Homolovi group, Chevelon Ruin, and Chavez Pass. Published accounts provide little detail concerning the nature of the excavations, the nature of the architecture at the sites, or the nature of any artifacts other than whole ceramic vessels.

Walter Hough (1903) developed survey records on a number of sites in the overview unit. His efforts focused on the Petrified Forest area, where several large sites were recorded, and in the area between Holbrook and Show Low. Hough visited Show Low (Huning, Whipple) Ruin, Shumway Ruin, and a variety of other sites in the area. His records are insufficient for relocating the majority of these, and some very large sites that he describes have not been noted by subsequent investigators.

Palmer (1905) excavated at three sites in the overview unit. One of these is located 25 miles south of Snowflake and may be Show Low Ruin. The others are identified as the "Juniper Ridge" ruins and may or may not correspond with the ridge currently identified by that name. Palmer also indicates that he "visited" 80 other sites although there is no indication that any survey records were developed. His description of the sites at which he worked is minimal. Of considerable interest, however, is the following observation:

> . . . in no case did I find any part of the wall standing above ground. But only in part is this utter devastation to be attributed to natural causes. Men now living in the section where these ruins are found have told me that the destruction has been greater in the last ten than in the preceding twenty years--by vandal relic-hunters, ravages of stock, and

> last but by no means least, the despoilation of these ancient monuments by people living near them. The walls are thrown down, the stones hauled away and used in private residences and even for public buildings. (1905:531)

> From September 11th to 15th I visited a number of ruins, but found in each instance that I have been preceded by others who had made more or less thorough research. In every case, the burial place had been looted; in fact, the only apparent object of those who had committed these depredations was to obtain pottery from the graves. There were no evidences whatever of any scientific work, save only that which I was informed had been performed by representatives of the government. (1905:533)

In my experience, there is little evidence today of the magnitude of destruction that Palmer describes in the area. This circumstance raises the most unpleasant possibility that many sites appearing to be undamaged at present were in fact devastated a sufficiently long time ago that the site surfaces have returned to an undisturbed appearance. This seems even more likely in view of the following comment:

> The traffic in prehistoric wares from the Holbrook district has been deplorably active. Many thousands of pieces of excavated pottery have been shipped from Holbrook alone, and collections embracing several thousands of pieces are now in the hands of dealers at various towns in the district, and are offered for sale. These collections have been made, for the most part, by Indians and native Mexicans in the employ of the traders . . . . (Hewett 1904:9)

Leslie Spier (1918) undertook a survey of sites in the planning unit. There is substantial correspondence between the sites he visited and those identified by Bandelier, Fewkes, and Hough. Locational information is poor, however, and it is impossible to say with any confidence how many of the sites he recorded had not been previously recorded by his predecessors.

One major excavation for which no records apparently exist occurred at the site of San Cosmos to the southeast of St. Johns. Artifactual materials from the site are at the Field Museum of Natural History and the approximate location of the site is shown in one publication (Martin and Willis 1940). However, no records of the excavation were found at the Field Museum. (This site may in fact be Homolovi ruin, nowhere near St. Johns.)

It is worth noting that up to this point in time other portions of the Southwest were experiencing more substantial archeological attention. Moreover, standards of field work and reporting were apparently higher elsewhere. As a result, Kidder (1924) has very little to say concerning the prehistory of the study area in his synthesis of Southwestern prehistory.

During the 1930s better work was reported for the overview unit. Haury and Hargrave (1931) conducted excavations at Kintiel, Show Low, Pinedale, and Bailey (Stotts Ranch) Ruins. Their effort was intended primarily to recover tree ring specimens from these sites to flesh out the master plot of the dendrochronology. As a result, architecture and artifacts are poorly described.

The first high quality report produced from the area was a result of Roberts' work at Kiatuthlanna (1931). He excavated 18 pithouses, 5 jacal structures, and 53 pueblo rooms at this particular location. Architecture, ceramics, and skeletal material are described in detail as is the nature of the excavation itself. It was on the basis of this work that Roberts argued for an evolutionary sequence from pithouse to jacal to masonry structures. It should be noted, however, that the ceramics from the various structures are of similar styles raising the possibility that all of these different architectural units were in use at the same time.

In 1933, H. P. Mera conducted survey and excavations in the vicinity of the Petrified Forest. He excavated and restored Agate House and a second site immediately adjacent to the Rio Puerco. One hundred nine sites within and near the Petrified Forest and in the McDonald Wash area west of Holbrook were recorded. The resulting publication (Mera 1934) provides only minimal information concerning the results of the effort and Mera's analysis is restricted largely to ceramic typology.

In 1939 and 1940, Frank Roberts described the results of three summers' work at sites in the Whitewater District. Again, he excavated in architecturally diverse situations including 20 pithouses, a number of small pueblos and granaries and a large pueblo that appears to have the characteristics of a Chacoan outlier. Ceramic artifacts and burial patterns (there were 150 excavated burials) are described in detail.

In 1942, Katharine Bartlett described evidence recovered from aceramic sites in the Little Colorado River Valley. She labeled these sites the Tolchaco Focus and argued that the flaked stone industry resembled Lower Paleolithic ones found in the Old World. While no specific date was assigned to the sites, she argued that they must be earlier than AD 500 because of the absence of pottery on them. This complex, and its interpretation as a "pre-projectile point" phenomenon, has been the subject of a continuing dialogue in the literature (Ascher and Ascher 1965; Sims and Daniel 1967, Keller and Wilson 1976).

In 1945, Harold S. Gladwin (1945) reported on his major effort at White Mound Village. Six pithouses, surface storage rooms and additional features were excavated. The report provides a detailed architectural description and an analysis of ceramic variation along with consideration of some other artifact classes.

Fred Wendorf (1948) summarized patterns of ceramic variation on sites in the Petrified Forest area. Continuing work by the staff of the Laboratory of Anthropology, subsequent to Mera's initial effort in the area, had increased the total of known sites in this location to 304. On the basis of ceramic types, Wendorf divided the sites into seven distinct temporal units.

In 1949, George Ennis described the results of a survey of a ranch east of Snowflake. Mr. Al Levine, the owner of the ranch, had previously identified sites on it. Ennis revisited and made ceramic collections from 82 sites on the ranch. Ceramic variation is used to generate a system of seven ceramic groups. Prehistoric population of the ranch is reconstructed using room counts.

In 1950, Wendorf described the excavation of eight pithouses at the Flattop Site in the Petrified Forest National Monument. The report includes brief architectural and ceramic summaries. Because pottery at the site was Adamana Brown, a micaceous, paddle-and-anvil plainware, atypical of the Plateau area, Wendorf chose not to assign the site to any time period or cultural group.

Danson and Malde (1950) published a brief description of Casa Malapais, near Springerville, Arizona. Architecture and ceramics are briefly described. The site is a Pueblo IV site with roughly 60 rooms and a Great Kiva. Because access to the site is difficult and because it is virtually invisible from any surrounding location, the authors agrue that it was a defensive site.

Wendorf (1951) described the excavation of the Twin Butte Site in the Petrified Forest National Monument. The site is a Basketmaker III village from which 12 structures and 8 burials were excavated. The report is a brief description of architectural, ceramic, and burial patterns. In 1953, Wendorf (1953) published a summary of his work at Flattop, Twin Butte, and one large and relatively later pueblo. This report is the most complete synthesis of his work and the most comprehensive of the available discussions of the prehistory of this locality.

Wendorf and Thomas (1951; Thomas 1952) described artifactual materials from lithic sites near Concho. The materials have a relatively extensive distribution on hillslopes in the area. They argue that the "Concho Complex" is a local Desert Culture manifestation.

Danson (1957) discusses the results of his surveys in western New Mexico and eastern Arizona. Two of the localities he surveyed are within the study area. Near Nutrioso, he recorded nearly 50 sites and in the Springerville-Eagar area, nearly 60. The report contains a summary of architectural and artifactual patterns, the evolution of ceramic types, and patterns of cultural variation.

In 1957, the Southwest Archeological Expedition of the Field Museum of Natural History began its excavations in the Upper Little Colorado portion of the study area. This effort resulted in publication of two surveys, one in the Little Colorado area in general (Rinaldo n.d., Longacre 1962, 1964, 1970) and one in Hay Hollow Valley (Plog

1974, Zubrow 1975). Excavation was undertaken at the Beach Sites near Concho (Martin and Rinaldo 1960), sites 30 and 31 near Vernon (Martin and Rinaldo 1960a), Table Rock Pueblo near St. Johns (Martin and Rinaldo 1960b), Tumbleweed Canyon near Lyman Lake (Martin et al., 1962), Rim Valley and Hooper Ranch Pueblos near Springerville (Martin, Rinaldo, and Longacre 1961; Martin et al., 1962), Mineral Creek Site, Thode Site, and Chilcott Sites near Vernon (Martin, Rinaldo, and Longacre 1961; Martin et al., 1962), the Goesling Site near St. Johns (Martin et al., 1962), Carter Ranch (Martin et al., 1964, Longacre 1970), Broken K (Martin, Longacre, and Hill 1965, Hill 1970), County Road, Hay Hollow (Martin 1967, Fritz 1974), Plebisite (White 1968), Gurley (Plog 1974), Joint (Martin et al., 1975), and the Kuhn and Connie sites in Hay Hollow Valley (Thompson and Longacre 1972). Gregory (1975) and Zubrow (1975) report test excavations at a number of sites in the same valley. Longacre and Graves (1976) have reported on surface studies at a PaleoIndian Desert Culture site near St. Johns. Excavations at Swinburn Cave and the Hatch Site, and the Phipps Site are undescribed and unpublished. Earlier site reports generally provide a comprehensive discussion of artifactual and architectural variation at the sites. Later reports reflect a stronger problem orientation, but the general description of architectural and artifactual variation is poor.

In 1960, William Wasley described the results of salvage excavation along U.S. Highway 66 between Houck and Lupton. Excavation occurred at 10 sites and resulted in recovery of information concerning 16 pithouses, 43 surface rooms, 7 kivas, 6 trash deposits and 18 burials. Little detailed artifactual or architectural information is presented. The author notes the presence of contemporary pithouse and pueblo settlements until as late as the Pueblo II period and also comments on the substantial admixture of Anasazi and Mogollon traits in the area.

Jack Sims and D. Scott Daniel (1962) describe chipped stone artifacts from a site immediately to the west of Winslow. Projectile points recovered by an amateur collector were studied. The authors argue that there is evidence of both Clovis and Pinto occupations at the site.

The excavation of a painted kiva near Winslow was described by Pond (1966). The kiva at Homolovi II contained Jeddito Black-on-yellow pottery. Wall paintings were fragmentary.

Gumerman (1966) reported the excavation of 13 pithouses at two aceramic sites along Highway 66 between Sanders and Lupton. The architectural patterns at the two sites are described and compared to reports of Basketmaker II houses elsewhere in the Southwest. Artifactual materials recovered during excavation are briefly mentioned.

Beeson (1966) described the results of a survey in the Little Colorado and Zuni River confluence area that he undertook between 1956 and 1958. The intensity of the survey was variable. Three hundred and twenty-five sites were recorded. Ceramic and architectural data are presented and used in assessing the temporal and cultural placement of sites within the survey area.

In 1967, Calvin Jennings (n.d.) summarized the results of Museum of Northern Arizona excavations at Puerco Ruin in the Petrified Forest National Monument. Fifteen rooms, two kivas, and a burial were excavated. The report includes detailed architectural and artifactual information. The site was occupied between AD 1250 and 1350.

Vivian (1967) discussed the excavation of three sites near Concho and Hunt. Two of the sites are prehistoric: one was a twelfth century single room structure, inferred to be a field house, and the second was a Basketmaker III slab lined pithouse. The third site was a three room Mexican homestead. Artifactual and architectural remains are briefly summarized.

In 1968 Gumerman and Skinner published a summary of the prehistory of the central Little Colorado Valley. While the primary focus of the article is an area along the north edge of the overview unit between Holbrook and Winslow, much of the discussion is relevant to the overview unit itself. The primary utility of the article is the summary of temporal variation in architectural, artifactual, settlement, demographic, and cultural patterns.

Gumerman and Olson (1968) provided a similar synthesis of the Puerco area between Sanders and Lupton. Their article

adds some additional information to Wasley's (1960) description that was discussed earlier. It is perhaps worth noting at this point that salvage archeology in conjunction with the construction of I-40 continued through the early 1960s. Unfortunately, apart from the Wasley and Gumerman-Olson articles, the results of this major effort are unreported. Field notes and artifactual materials remain at the Museum of Northern Arizona.

Gumerman (1969) described the archeology of the Hopi Buttes district. This area lies to the north of the overview unit. However, many of the evolutionary patterns discussed by Gumerman are characteristic of the study area. The report describes both survey and excavation in the area and contains detailed architectural and artifactual summaries as well as a thorough discussion of spatial and temporal variation in demographic, subsistence, and technological patterns.

Wilson (1969) discussed the results of survey in a number of localities between Flagstaff and Holbrook, some of which lie within the study area. The survey coverage itself is spotty. However, the volume contains a major synthesis of Sinagua prehistory and much detailed discussion of ceramic types and ceramic variation over the area. The survey is briefly summarized in one earlier report (Wilson 1967).

Vivian (1969) reported the results of salvage excavations by the Arizona State Museum near Pinedale, Arizona. Five sites were excavated, two of which had no structures. The remaining sites include a two room and a three room pueblo and a pithouse village with an associated work area. Architectural and ceramic remains are very briefly summarized.

Grebinger and Bradley (1969) described the result of excavation near Heber associated with the same project. The site is a double component temporary camp site consisting of work areas around hearths. The first occupation was before AD 1000 and the second sometime afterwards. Artifactual summaries are provided.

Lindsay et al., (1969) summarized the results of a survey done in conjunction with a proposed dam project on Clear Creek. Nine sites were recorded including petroglyphs and rock shelters. Descriptive detail is minimal for all pertinent observations.

In 1970, DeGarmo began survey work in the Coyote Creek drainage. Sixty-three sites were recorded between the headwaters of the creek and its confluence with the Little Colorado River. During the next year DeGarmo (1975) excavated at Coyote Creek Pueblo. The report includes detailed architectural and artifactual summaries and an interpretation of productive and organizational patterns at the site.

In 1973, Harrill described the result of excavation at the DoBell Site, a large pithouse village south of the Petrified Forest. Four pithouses and one kiva were excavated. The report includes detailed information concerning architecture, artifacts, and burials (see also Birkby 1973).

In 1975, Donaldson reported the results of a 1% sample survey of the White Mountain Planning Unit on the Apache-Sitgreaves National Forest. His monograph focuses principally on the distribution of sites over the planning units and employs computer mapping in this task. A summary of local cultural history is also provided.

In 1976, F. Plog, Hill, and Read reported the results of survey in the Chevelon drainage south of Winslow. The results summarize ceramic and architectural patterns and discuss analytical approaches that are taken in the project.

In 1977, Hantman described the results of a survey of an 800 acre area in the Chevelon drainage. Thirty-one sites were located during the survey. In addition, non-site manifestations within the study unit are discussed. Sites are described but there is little architectural detail. The report includes a detailed analysis of ceramic variation over the sites in the study area.

In 1977, Lightfoot and DeAtley discussed the results of a survey of an 8 square mile area near Pinedale, Arizona. Ninety-one sites and non-site areas were identified in the study. The report includes a detailed analysis of locational patterns within the area, but no summary of artifactual or architectural remains. In 1978, Lightfoot described the results of survey in an immediately adjacent area of similar size. Sixty-one sites and additional non-site areas are discussed. The report includes a

summary chronology for the area, but no detailed analyses of ceramic or architectural patterns. Ceramic variation is described in some detail in a subsequent report (Lightfoot 1981).

In 1978, Plog (1978) and others described the results of survey in the Springerville-Alpine area. Roughly 60 sites in the area were located during a 1% planning survey. The report includes detailed analyses of architecture and variation in chipped and ground stone artifacts. Settlement and locational patterns are also analyzed.

In 1979, Lerner described the results of a 1% planning survey in the Clear Creek and Chevelon drainages (Lerner 1979a, b). Eighty-nine sites were located. The reports briefly describe architectural patterns in the area. Ceramic and locational patterns are discussed in detail.

Doyel (1979, in press) discusses the results of a survey and excavation project north of Springerville. Twenty-five sites were located and excavation was undertaken at ten of these. The report contains detailed information on architecture, artifacts, flora, and fauna recovered during the study. The sites in question appear to be temporary agricultural camps the majority of which were inhabited between AD 900 and 1150. In the same year, Doyel discribed the results of the excavation of a small pueblo east of Springerville.

Stewart (1980) has completed an overview of the Petrified Forest National Park. In point of fact, the discussion in the overview covers much the same area that this one does. Its focus is more heavily on space-time systematics and it thus provides information that is complementary to this study. Sites and projects in the Park itself are summarized in the document.

The Museum of Northern Arizona (various authors, in press and in preparation) has undertaken a study in conjunction with the construction of the Coronado generating station and associated facilities. Early reports on this effort are very sketchy. The overall results of the project are, however, now being summarized and include a number of important detailed studies of architectural, artifactual, subsistence, and palynological patterns. The study locations are scattered throughout the study area and the results of this project will be crucial to understanding the area's prehistory.

A parallel project associated with the Cholla generating station is currently being summarized by archeologists at the Arizona State Museum (Teague and Mayro 1979; others in press and in preparation). Survey in conjunction with this project resulted in the location of several dozen sites within the study area, and excavation and/or detailed surface mapping has been done at a sample of these. The report will again obtain detailed analysis of architectural and artifactual patterns within the area.

One major unreported project, the results of which are being summarized currently, is the continuing efforts of the Chevelon Archeological Research Project. Between 1971 and 1978, survey records were developed on roughly 1500 sites on the Apache-Sitgreaves and Coconino National Forests. Thirty-six architectural units on some twenty sites were excavated. The only excavations reported in detail to date are rockshelters in Chevelon Canyon (Briuer 1977). Architectural, artifactual, palynological, and especially subsistence variation are described in this report.

A major omission in the preceding discussion of the later history of archeological research in the overview area is information concerning numerous small projects done either by institutions under contract or by agency employees. In general, these reports are highly variable both in substance and quality. Many contain little more than a description of sites encountered equivalent to what would be found on a site survey form. Thus, the records of the projects available at present consist substantially of the site survey records themselves.

Southwestern institutions that house the majority of the site records, excavation records, and artifactual materials are Arizona State University, the Laboratory of Anthropology, Museum of New Mexico, the Museum of Northern Arizona, the University of Arizona, and the Western Archeological Center of the National Park Service. Outside of the Southwest, the Field Museum of Natural History and the Smithsonsian Institution house major collections. The American Museum and the Heye Foundation

also have pertinent materials. While there are records of research in the area by scholars from California institutions, no evidence that the pertinent materials still exist could be found. In all cases, the material items held are incomplete, reflecting the once accepted practice of disposing of some classes of artifacts. Unfortunately, in some instances the degree of disposal was relatively complete. Burial data from the overview unit and nearby areas has been summarized by Turner (1967).

# PREHISTORY OF THE OVERVIEW UNIT

## INTRODUCTION

There is a major problem in developing a summary of the prehistory of this or any other large spatial unit, one that arises because archeologists have sometimes been careless in the extent to which chronologies were based on developmental as opposed to strictly chronological concepts. Chronological terminologies use distinctive artifactual styles, sometimes in combination with absolute dates, to isolate relative or absolute temporal horizons. Developmental terminologies on the other hand postulate a regular evolution of architectural, artifactual, and/or settlement forms. In general, the postulated evolutionary trajectory is linear and involves increases in complexity, technological sophistication, aesthetic appeal or some combination of these.

Price (1975), Millon (1975), and Cordell and Plog (1979) have discussed problems that arise when developmental terminologies are used as, or incorporated into, chronological terminologies or when the distinction between the two is not kept clear. Empirical research increasingly demonstrates that many, if not most, prehistoric societies survived on the basis of exchange relationships that linked at least productively and sometimes culturally, different groups. Given such diversity, a developmental typology created to describe the prehistory of one region or locality may be inappropriate to one quite close by. Yet, in efforts to synthesize regional prehistory, diverse regions and localities can be and have been forced into monistic frameworks.

Theoretical literatures dealing with evolutionism increasingly emphasize concepts such as "saltation" or punctuated equilibrium (Gould 1977; Gould and Eldridge 1977). These developments are paralleled by changes in approaches to historical sequences that emphasize the uneven course of development from region to region that underlies the emergence of larger and more complex pan-regional systems (Wallerstein 1974). These approaches again raise doubts as to the likelihood of constructing a single regional developmental chronology.

At this point, it is impossible to avoid describing the prehistory of the overview area in developmental terms, because so many of the studies undertaken in the area have used such approaches. For this reason, the prehistory of the area will be described from a number of perspectives. First, a summary description in terms of traditional developmental typologies will be provided. Because of the difficulties just discussed, no effort will be made to identify each and every cultural resource in relation to this typology. Second, more reliable chronological approaches and data will be summarized. Finally, specific dimensions of diversity will be described and an attempt will be made to describe the complexity of evolutionary patterns in the study area.

## PALEOINDIAN

PaleoIndian sites are the earliest found within the overview unit. In general, these are defined by the presence of lanceolate projectile points with either short (Clovis) or long (Folsom) flutes (Figure 6). The precise date of the earliest occupation of the area cannot be established at present. Sites older than 20,000 years have been identified in Mexico (Irwin-Williams 1967) and in South America (MacNeish 1971). Given the generally accepted hypothesis that the first inhabitants of the New World came from Asia across the Bering land mass, it is likely that prehistoric peoples either passed through or inhabited the study area before 20,000 years ago. At present there is no corroborating evidence. The site of Tule Springs in southern Nevada dates from 10,000 to 13,000 years ago suggesting PaleoIndian presence in the southwestern region by this time. But, again there are no corroborating dates from the study area.

The earliest certain evidence of prehistoric activity in the area is the presence of Clovis points near Sanders (Danson 1961; Olson 1964) and west of Winslow (Sims and Daniels 1962). While the two points in question are surface finds, Clovis points elsewhere in the Southwest date to between 9000 and 9500 BC (Irwin-Williams 1967:8).

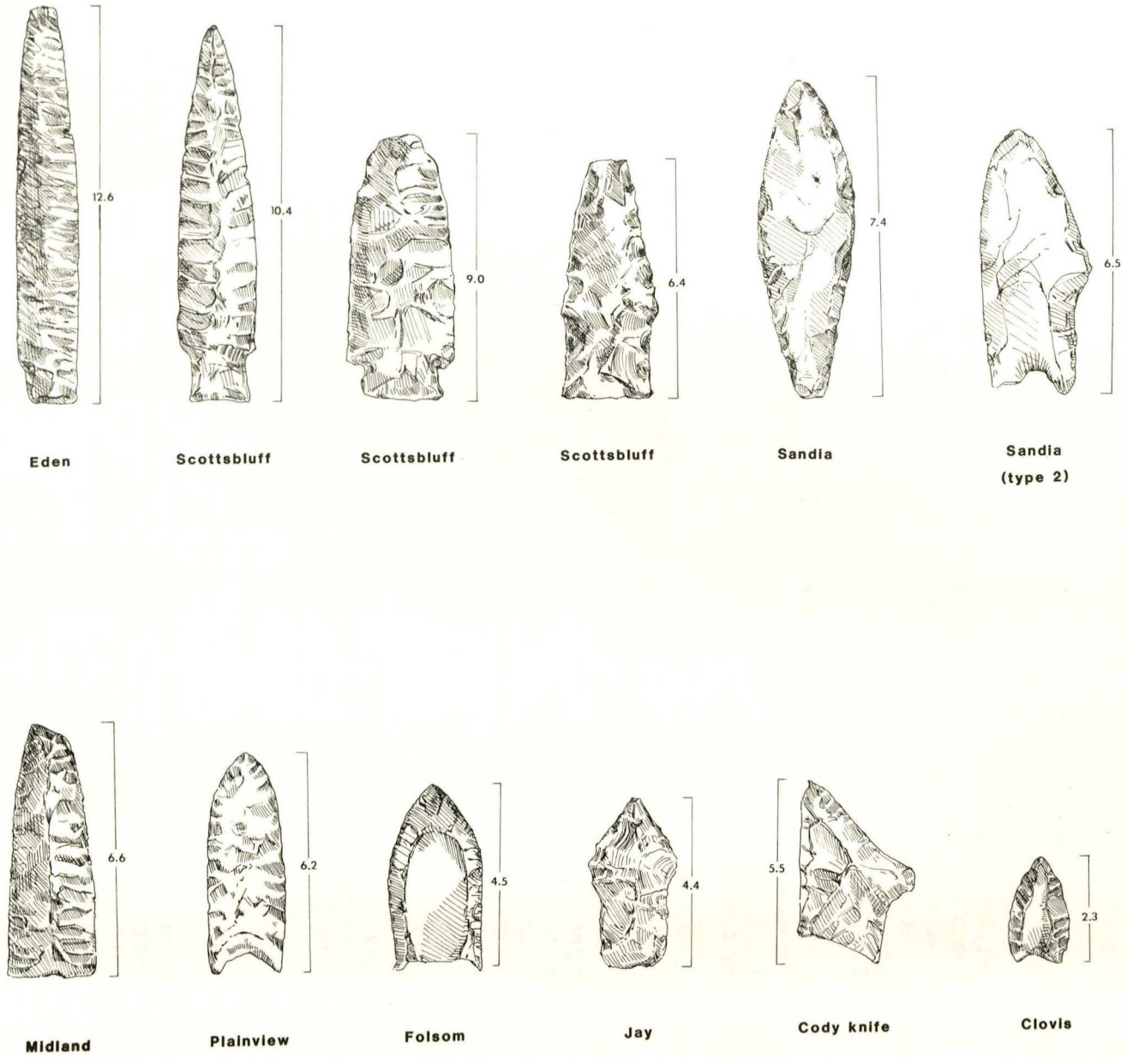



Figure 6. Early projectile points. All measurements are given in centimeters.

These points represent, therefore, the earliest reasonably certain evidence of human habitation of the area.

A possible candidate for equal or greater antiquity is the Tolchaco Complex (Bartlett 1942, 1943; Ascher and Ascher 1965; Keller and Wilson 1976). While Bartlett originally assigned the sites of this complex to a time earlier than AD 500, Krieger incudes it in a Pre-Projectile Point Stage, implying that it is earlier than Clovis (Krieger 1962, 1964). Fish (1974) and Keller and Wilson (1976), however, argue that the sites are quarry and lithic processing sites. This is based upon large quantities of cores and chipping debris. Keller and Wilson (1976) conclude that the sites were utilized from Archaic through Pueblo times.

This interpretive problem results from the nature of the sites. Those that I have observed are better characterized as low density artifact scatters than as sites. That is, they can and sometimes do occur as very low density scatters over an area of many hundreds of square meters. Site "boundaries" are often formed by erosional channels with the artifact distributions occurring again on the other side of the wash.

The sites occur in the midst of lag gravels and include materials derived from the Kaibab Limestone, the Moenkopi Sandstone and the Mogollon Rim Gravels. The ratio of unmodified gravel and cobbles to worked pieces is quite high. There are occasional sherds on some sites and lithic materials that are indistinguishable from those found on Pueblo period sites.

At the same time, I have observed and others have reported to me (Jewett, personal communication) artifacts that are not generally associated with typical Paleo-Indian or Archaic assemblages of the area. Of particular importance are at least three residual turtle-back, or Levallois, cores observed at sites southeast of Winslow. The presence of such cores does not necessarily argue for assigning Tolchaco to a Pre-Projectile Point stage. It does, however, suggest that the gravels were utilized by peoples with a lithic industry different from that typical of the area during any currently well described time period.

Thus, in my mind, the Tolchaco issue remains unresolved. That known cultural and temporal markers are found on the sites does not preclude their use as quarry sites by earlier or culturally different peoples. That this problem will ever be resolved is uncertain. The sites are surface sites and, given the attention they have received and the extensive erosion in the areas where they occur, it is reasonable to expect that buried components would by now have been found. The most pressing need for future research concerning the phenomenon is an attempt to identify loci where either superposition or the presence of dateable materials will allow a genuine chronometric approach to the problem.

The next cultural complex evident in the area is Folsom, which typically dates to between 8200 and 8800 BC (Irwin-Williams 1980). Folsom points have been identified near Sanders, St. Johns (Agenbroad 1967; Longacre and Graves 1976), Concho (Agenbroad 1967), Winslow (personal observation), and Springerville (USDA Forest Service site files). With one exception, the points are isolated surface finds. (In addition, the point from south of Winslow came from what is described as a Folsom site. However, the landowner refused access to the site and its existence cannot, therefore, be verified.)

The Vernon site southwest of St. Johns has yielded considerably more information than the isolated surface finds. Longacre and Graves (1976) describe the sample collections that were made on the site surface. Two components were identified, a Concho Complex and a "fluted point" component. While they are reluctant to identify the fluted points as Folsom points, they are similar to Folsom points and the differences may easily be attributable to the basalt used in manufacturing chipped stone artifacts at the site. (It is generally more difficult to fashion refined forms from the basalt available in the area.) Wilmsen (1970:80) analyzed functional attributes of chipped stone artifacts found on the site and concluded that stone tool manufacture and repair, plant and seed processing, and butchering all occurred at the site. This result suggests that Folsom populations were at least seasonally resident in the area. All of the remaining evidence suggests only that they were passing through the area.

Clearly, little is known concerning the PaleoIndian occupation of the area. In general, archeologists are quite sensitive

to Clovis, Folsom, and other PaleoIndian point types. A far greater quantity of materials is known from southeastern Arizona and from New Mexico (Irwin-Williams 1980). Given the likelihood that, for much of the period in question, the study area was covered by pine parkland (see earlier environmental discussion), it may have been marginal to the major PaleoIndian population centers in the Southwest.

## DESERT CULTURE

Desert Culture sites are distinguished from PaleoIndian sites on the basis of the replacement of lanceolate projectile points by stemmed and side-notched points, and the addition of a substantial ground stone tool complex. While PaleoIndian sites are said to lack ground stone tools, there is clear evidence to the contrary (Duncan 1968, Longacre and Graves 1976). Nevertheless, it is reasonable to argue that the abundance and diversity of ground stone tools was greater during the Desert Culture period. The most typical forms are round or oval cobble manos and basin shaped metates. Desert Culture sites are differentiated from later sites on the basis of the absence of pottery and, possibly, differences in projectile point forms. While the hunting of Pleistocene megafauna and other big game was important to PaleoIndian groups, Desert Culture peoples relied on a diet of gathered resources and small game.

Desert Culture manifestations are known to occur throughout the area. Generally, these can be divided into two complexes: the Pinto Complex and the Concho Complex. Pinto points are stemmed and have indented bases and serrated or rough edges. Concho Complex points are generally thinner, more triangular or lanceolate and side-notched, although they do sometimes have indented bases. In general, Pinto points are found to the north and the west of the overview unit, while points similar to those of the Concho Complex are more common to the east. In my opinion, the remainder of the chipped and ground stone tools are quite similar in the two complexes as they are manifested within the study area.

Pinto points are known from the vicinity of Houck (Gumerman and Skinner 1968), west of Winslow (Syms and Daniel 1967) and at O'Haco Rock Shelter and other nearby sites in the Chevelon drainage (personal observation). Points of the Concho complex are known from the Vernon site (Longacre and Graves 1976), the Beach sites (Martin and Rinaldo 1960), the Hay Hollow site (Martin 1967; Fritz 1974), and from the Concho area generally (Wendorf and Thomas 1951; Thomas 1952).

Irwin-Williams (1967) has argued that the study area represents a boundary between the various traditions that she defines within Picosa culture, the term she uses for specifically Southwestern Desert Culture manifestations. In general, the data from the overview unit support her argument; Concho complex materials are more common to the south of the Little Colorado River and to the east of Silver Creek, while Pinto materials are more common to the north of the Little Colorado River and to the west of Silver Creek. However, given the relatively small number of points in question, and the problems inherent in interpreting projectile point styles as distinctive of different cultural groups, the precise interpretation of the pattern is a problem. The evidence suggests a style boundary, but considerable research is necessary to provide any meaningful cultural or behavioral interpretation of that boundary.

Dating the Desert Culture remains within the study area is also problematical. The earliest dates are from O'Haco Rock Shelter (Briuer 1977). The basal deposit there dates to about 7000 to 8000 BC. Associated cultural materials cannot be classified as either clearly PaleoIndian or clearly Desert Culture. The overlying stratum dates to between 2000 and 3000 BC. This stratum contains Desert Culture materials and also primitive corn cobs. Continued occupation of the rock shelter on at least an intermittent basis continues until AD 1, the traditional date for the end of the Desert Culture. The deposits are not sufficiently well stratified, nor are cultural materials sufficiently abundant, to use in defining a detailed cultural sequence for the area.

A widespread occupation of the study area is not suggested until substantially later. An open air site near O'Haco rock shelter with Desert Culture-like artifacts and a hearth (CS-193) yielded a date of 810± 170 BC (all radiocarbon dates used herein are tree-ring corrected). The Desert Culture

camp site on the shore of Laguna Salada is radiocarbon dated to somewhere between 1850 and 1770 BC (3520 BP± 60 [GrN-1614]). The County Road Site in Hay Hollow Valley (Reals 1965) has three dates: 1300 BC± 75 (GX0274), 410 BC± 70 (GX0272), and AD 30± 50 (GX0273). The Hay Hollow Site is dated to between 420 BC and AD 260 (Fritz 1974).

Materials are insufficient for describing the settlement pattern during this stage in any great detail. Martin observes that the Desert Culture sites at Laguna Salada and Little Ortega Lake were very different; the artifact assemblage at the former contained a great quantity of manos and milling stones while that at the latter is largely chipped stone (1960:114). A similar situation may characterize the Desert Culture sites along Chevelon Creek.

Should this apparent pattern be confirmed, then the existence is indicated of specialized activity loci at which drastically different activities were carried out. It is unlikely that the two excavated sites with houses, County Road and Hay Hollow, represent true villages. Even given the overlap of a two sigma range around the dates, it is improbable that the County Road houses were contemporaneous. It is difficult to argue that the inhabitants of these earlier settlements were composed of more than a single family.

Diet was based largely on hunted and gathered materials. Briuer (1977) and Fritz (1974) provide detailed discussions of the floral and faunal evidence recovered from O'Haco Rock Shelter and the Hay Hollow Site respectively. Bohrer (1972) has discussed pertinent palynological evidence. At the same time, Bruier's comparison of cultural and nearby natural sites indicates that major caution must be exercised in attributing the presence of foodstuffs to human activity as the bulk of the floral and faunal inventories overlap.

Corn is present at Hay Hollow, County Road and at O'Haco Rock Shelter in levels dated to 3000-2000 BC. Cucurbits and beans apparently are present in later strata, although the results of analyses of cultigens are not yet published. One preliminary study (Schemenas 1974) argues that much of the corn at these and other sites in Chevelon Canyon was eaten while still green. It is not possible to argue at present that cultigens represented any substantial portion of the diet.

## THE PITHOUSE AND PUEBLO PERIODS

The major problem encountered in providing a coherent synthesis of regional prehistory during the PaleoIndian and Desert Culture periods is the paucity of data. When one begins to deal with the period of time after AD 1, data are no longer a problem as there are numerous excavated sites and even more numerous survey records. Nevertheless, there is a major synthetic problem, chronology. Cordell and Plog (1979) have discussed this problem at greater length than I intend to do here.

Briefly, the difficulty is twofold. First, there are relatively few chronometric determinations that sustain the various dating schemes used in the area. Second, "correlations" with dated loci have been pursued on the basis of arguable architectural and artifactual similarities. In addition, there are a variety of specific interpretive problems with respect to artifacts and architecture that will be considered in detail in subsequent chapters. Here, I intend only to review major approaches to chronology, identify basic problems with them, and discuss their relationship to actual chronometric determinations.

As noted earlier, one can identify two polar extremes in the approaches that archeologists take to the construction of chronologies: strictly chronological treaments and developmental ones. Between these poles are approaches that represent some combination of the two. All have been used in the study area.

The foremost of the strictly chronological approaches are those based on ceramics. Of course these embody a developmental element since they presume an orderly succession of ceramic types. However, this succession is viewed as a product of changes in "style" or "taste" and is, therefore, arbitrary in respect to major developments. The most clearly developed of these schemes is that used by Wilson (1969) in his survey of a number of localities, several of which lie within the study area. Wilson, following an approach originally used by Colton in a variety of his works, defined major "ceramic groups" in dating his sites. These ceramic groups are shown in Table 13.

Unfortunately, many of the ceramic types present in the eastern half of the overview area were not present in Wilson's survey

Table 13. Ceramic groups for the survey area

| | | | |
|---|---|---|---|
| Group 1: | A.D. 700s | DOMINANT: | Lino Gray<br>Lino Black-on-gray<br>Rio de Flag Brown |
| | | PRESENT: | La Plata Black-on-white<br>White Mound Black-on-white<br>Verde Brown |
| Group 2: | A.D. 800s | DOMINANT: | Lino Gray (mostly body sherds?)<br>Kana-a Gray<br>Kana-a Black-on-white<br>Rio de Flag Brown |
| | | PRESENT: | Coconino Gray<br>Medicine Gray<br>Probably Verde Brown |
| Group 3: | A.D. 900-1050 ± | DOMINANT: | Lino Gray (mostly body sherds?)<br>Coconino Gray<br>Medicine Gray<br>Tusayan Corrugated<br>Kana-a Black-on-white<br>"Early" Black Mesa Black-on-white<br>Black Mesa Black-on-white<br>Rio de Flag Brown |
| | | PRESENT: | Kana-a Gray<br>Diablo Brown, Yaeger Variety<br>Verde Brown<br>San Juan Red Ware (Deadmans Black-on-red) |
| Group 4: | A.D. 1050-1100 ± | DOMINANT: | Tusayan Corrugated<br>Black Mesa Black-on-white<br>Holbrook Black-on-white<br>Diablo Brown, Yaeger Variety<br>Sunset Brown Var. "A" alone or<br>Var. "B" Usually much less than "A" |
| | | PRESENT: | Diablo Brown<br>Diablo Red<br>Tsegi Orange Ware (Tusayan Black-on-red) |
| Group 5: | A.D. 1100-1200 ± | DOMINANT: | Walnut Black-on-white<br>Snowflake Black-on-white<br>Diablo Brown<br>Diablo Red<br>Sunset Brown Var. "A" and Var. "B" ("B" usually = "A")<br>Types II and IV Corrugated |
| | | PRESENT: | Tusayan Corrugated<br>Black Mesa Black-on-white<br>Sosi Black-on-white<br>Flagstaff Black-on-white<br>Holbrook Black-on-white<br>Padre Black-on-white<br>Diablo Brown, Yaeger Variety<br>Tsegi Orange Ware |

Table 13 (continued)

| | | | |
|---|---|---|---|
| Group 6: | A.D. 1200-1300 | DOMINANT: | Walnut Black-on-white<br>Snowflake Black-on-white<br>Diablo Brown<br>Diablo Red<br>Sunset Brown Var. "B" or Var. "B" much greater than "A"<br>Grapevine Brown<br>Types II and IV Corrugated |
| | | PRESENT: | Tusayan Corrugated<br>Moenkopi Corrugated<br>Flagstaff Black-on-white<br>Tusayan Black-on-white<br>Kayenta Black-on-white<br>Holbrook Black-on-white<br>Padre Black-on-white<br>Leupp Black-on-white<br>Pinedale Black-on-white<br>McDonald Painted Corrugated<br>Showlow Black-on-red<br>Klagetoh Black-on-yellow<br>Jeddito Black-on-orange<br>"Pinto-style" polychrome<br>Tusayan Polychrome<br>Kayenta Polychrome<br>St. Johns Black-on-red and Polychrome<br>(other 13th century polychrome types) |
| Group 7: | A.D. 1300 ± -1400 | DOMINANT: | Jeddito Black-on-yellow<br>Kinnikinnick Brown |
| | | PRESENT: | Bidahochi Black-on-white<br>Snowflake Black-on-white<br>Pinedale Black-on-white<br>Diablo Brown<br>Diablo Red<br>Kinnikinnick Red<br>Kinnikinnick Corrugated<br>Types VII and VIII Corrugated<br>Homolovi Corrugated<br>Tuwiuca Black-on-orange<br>Jeddito Black-on-orange<br>Bidahochi Polychrome<br>Homolovi Polychrome<br>Jeddito Polychrome<br>Chavez Pass Black-on-red<br>Chavez Pass Polychrome<br>Four Mile Polychrome<br>(other very late 13th and 14th century polychrome types) |
| Group 8: | Apache | DOMINANT: | Apache Plain |

localities and are not, therefore, included in his chronology.

A second approach used in the area in recent years is one that does not rely on the formulation of specific ceramic groupings but on the dating of individual sites using tree-ring dated ceramics. This approach utilizes Breternitz's (1966) study of the association between particular ceramics and dated wood samples. In some instances, the dates used are guesstimates utilizing a best approximation of the materials found at the sites (e.g., Plog 1974). In others, "mean ceramic dates" are calculated for each site using an average weighted by the relative quantities of each dated type (e.g., Lerner 1979a, 1979b). Dates for types likely to be found in the study area are given in Tables 14 through 18.

A third effort is that used in the Chevelon Archeological Research Project (F. Plog 1976). This chronology is a refinement of the Wilson approach that utilizes technological attributes of Black-on-white wares.

Ceramic criteria of successive time periods are shown in Table 19. The approach is a simplification of Wilson in the sense that the major changes in dominant types indicated by Wilson also embody shifts from one ware to another.

The two best examples of developmental chronologies developed for the area are those of Roberts (1935) (see Table 20) and Longacre (1964, 1970) (see Table 21). Robert's chronology was subsequently applied outside of the area while Longacre's was not. Although both chronologies are developmental they proceed along quite different lines. Roberts' focus was on material culture or technology. While specific material items replace one another through the sequence, there is a general pattern of increasing sophistication and complexity followed by a subsequent period of regression. Longacre on the other hand

Table 14. Associated tree-ring dates for plainware types likely to be found in the overview unit (after Breternitz 1966; dates rounded to nearest decade)

| TYPE | INDIGENOUS | BEST INDIGENOUS* | TRADE | BEST TRADE* |
|---|---|---|---|---|
| Alma | 270-950 | 300-950 | 780-1330 | |
| Angell | 910-1260 | | 1080-1130 | |
| Deadmans | 690-1210 | 780-1200 | 690-1120 | 850-1100 |
| Forestdale | 640-710 | | 610-1110 | |
| Lino | 350-1280 | 570-870 | 700-1050 | 700-880 |
| San Francisco | 740-950 | 760-950 | | |
| Sunset | 810-1280 | 1080-1140 | | |
| Tonto | 1110-1350 | | | |
| Winona | 810-1280 | 1080-1200 | | |
| Rio de Flag | 690-1260 | 800-1060 | 750-780 | |

*In this Table, and those following, "best" dates are those that bracket the major cluster of dates.

Table 15. Associated tree-ring dates for corrugated ceramics likely to be found in the Little Colorado inventory unit (after Breterniz 1966; dates rounded to nearest decade)

| TYPE | INDIGENOUS | BEST INDIGENOUS | TRADE | BEST TRADE |
|---|---|---|---|---|
| Alma | 740-910 | 760-910 | 640-710 | |
| Elden | 1030-1280 | 1090-1200 | 1020-1050 | |
| Kana'a | 680-1190 | 760-900 | 690-970 | 780-970 |
| Linden | 1080-1330 | 1280-1330 | 1030-1210 | 1130-1190 |
| McDonald | 1110-1330 | 1200-1300 | | |
| Moenkopi | 980-1390 | 1080-1290 | 810-1280 | 1080-1200 |
| Tusayan | 980-1390 | 1080-1290 | 800-1320 | 1000-1280 |

Table 16. Associated tree-ring dates for black-on-white types likely to be found in the Little Colorado inventory unit (after Breternitz 1966; dates rounded to nearest decade)

| TYPE | INDIGENOUS | BEST INDIGENOUS | TRADE | BEST TRADE |
|---|---|---|---|---|
| Black Mesa | 1080-1390 | 1060-1180 | 700-1280 | 880-1130 |
| Chaco | 830-1180 | 1050-1130 | 1070-1190 | 1070-1190 |
| Dogozhi | 980-1390 | 1140-1200 | 810-1280 | 1090-1200 |
| Escavada | 810-1280 | 930-1130 | | |
| Flagstaff | 980-1390 | 1120-1290 | 910-1320 | 1070-1200 |
| Gallup | 810-1280 | 1000-1130 | ca. 1190 | |
| Holbrook | 700-1280 | 1080-1130 | 1020-1060 | |
| Kana'a | 640-1290 | 730-820 | 670-1280 | 780-950 |
| Kayenta | 1100-1500 | 1200-1290 | 1020-1320 | 1270-1310 |
| Kiatuthlanna | 720-1090 | 850-910 | | |
| La Plata | 430-870 | 570-870 | 640-850 | 730-850 |
| Lino | 350-1280 | 570-870 | 700-1050 | 700-880 |
| Padre | 1090-1280 | 1100-1200 | | |
| Puerco | 810-1120 | 1010-1120 | 1080-1310 | |
| Red Mesa | 720-1230 | 880-1130 | 990-1290 | |
| Snowflake | 1010-1230 | 1100-1200 | 1080-1230 | |
| Sosi | 980-1290 | 1100-1190 | 810-1280 | 1080-1200 |
| Reserve | 930-1280 | 1070-1120 | 1010-1280 | 1030-1090 |
| Tusayan | 980-1290 | 1140-1290 | 960-1320 | 1090-1300 |
| Walnut | 910-1390 | 1090-1250 | 960-1280 | 1050-1200 |

Table 17. Associated tree-ring dates for polychrome types likely to be found in the Little Colorado inventory unit (after Breternitz 1966; dates rounded to the nearest decade)

| TYPE | INDIGENOUS | BEST INDIGENOUS | TRADE | BEST TRADE |
|---|---|---|---|---|
| Cameron | 1060-1140 | 1070-1140 | 920-1130 | 1120-1130 |
| Cedar Creek | 1230-1350 | 1300-1350 | 1200-1310 | 1270-1300 |
| Cibicue | 1320-1350 | 1340-1350 | | |
| Citadel | 1050-1290 | 1120-1200 | 910-1280 | 1120-1200 |
| Four Mile | 1130-1390 | 1300-1390 | 1030-1390 | 1300-1390 |
| Gila | 1110-1390 | 1250-1390 | 1130-1390 | 1270-1390 |
| Heshotauthla | | | 1050-1610 | 1300-1400 |
| Kayenta | 1100-1500 | 1270-1290 | 1020-1280 | |
| Kiet Siel | 1100-1290 | 1250-1290 | 1070-1280 | |
| Kinishba | 1230-1310 | 1300-1310 | 1300-1350 | 1340-1350 |
| Maverick | 1200-1310 | 1270-1290 | | |
| Pinedale | 1130-1350 | 1300-1350 | 1110-1350 | 1280-1300 |
| St. Johns | 1030-1310 | | 960-1610 | 1200-1300 |
| Show Low | 1180-1380 | 1300-1380 | | |

Table 18. Associated tree-ring dates for black-on-red, yellow, and orange types likely to be found in the Little Colorado inventory unit (after Breternitz 1966; dates rounded to the nearest decade)

| TYPE | INDIGENOUS | BEST INDIGENOUS | TRADE | BEST TRADE |
|---|---|---|---|---|
| Abajo | 610-870 | 760-880 | 610-1120 | 700-900 |
| Deadmans | 840-870 | 860-870 | 680-1110 | 780-1070 |
| Gila | | | 1130-1350 | 1300-1350 |
| Jeddito | 1260-1430 | 1300-1400 | 1030-1610 | 1300-1400 |
| Klageto | 1170-1280 | 1270-1280 | 1170-1280 | 1270-1280 |
| Medicine | 980-1220 | 1080-1130 | 910-1160 | ca. 1100 |
| Pinedale | 1130-1350 | 1280-1350 | 960-1350 | |
| St. Johns | | | 1140-1390 | |
| Tsegi | 980-1290 | 1130-1290 | | |
| Tusayan | 980-1290 | 1090-1290 | 810-1280 | 1050-1200 |
| Show Low | ca. 1200 | | 1110-1270 | 1030-1180 |

Note: These types represent only a small percentage of Black-on-red, orange, and yellow types known from the area. The majority of types are poorly dated.

Table 19. Chevelon chronology

| TIME PERIOD | PREDOMINANT WARE |
|---|---|
| AD 1200-1275 | 80 percent or greater Cibola White Ware (PGM) |
| AD 1125-1200 | Mixture of Cibola and Little Colorado White Ware |
| AD 1050-1125 | 80 percent or greater Little Colorado White Ware (SShO) |
| AD 800-1050 | Predominance of Tusayan White Ware (PSO) |
| AD 500-800 | Early Cibola and Tusayan Types (Lino, La Plata) |
| AD 300-500 | Predominance of Plainwares (Mogollon Brownware, Alameda Brownware, Tusayan Gray Ware) |

Note: For an explanation of the Chevelon "alphabetic" ceramic typology see the discussion in "Ceramic Technology."

focuses on the establishment of agriculture and large villages within the area, although he ultimately uses ceramics to date each of the phases. Plog (1974) modified the Longacre chronology for analyzing sites in the Hay Hollow Valley.

Between the ceramic and the developmental chronologies are a number that are explicitly neither, but draw on elements of each. Fundamentally, these efforts develop from Kidder's (1924) Pecos chronology. Kidder's chronology, which embodies more and shorter time periods and lacks the explicit developmental focus of Roberts', is shown in Table 22.

Modifications of the Pecos chronology began with the advent of tree-ring dating and a gradual increase in the number of localities to which archeologists attempted to apply the scheme. Gladwin's (1945) (see Table 23) was one of the first systematic efforts to use tree-rings in attempting to define a local sequence. While these dates were used to establish phase boundaries, architecture and ceramics continued to be the major criteria employed in defining the material culture of each phase.

Later efforts by Wasley (1960), Rinaldo (n.d.), and Gumerman and Skinner (1968) further diversify the specific temporal boundaries that were used to separate phases and the specific ceramic and architectual forms that are said to be associated with particular periods (see Tables 24 through 26). In the case of the Wasley and

Table 20. Robert's developmental chronology

| PERIOD | DEFINING CHARACTERISTICS |
|---|---|
| Basketmaker<br>AD 1-400 | primitive corn and squash; slab-lined cists; atlatl wood houses over saucer shaped depressions |
| Modified Basketmaker<br>AD 400-700 | sedentary existence; new variety of corn; beans; slab-lined pithouses; plainware ceramics; occasional painted types; bow and arrow |
| Developmental Pueblo<br>AD 700-1100 | pithouses; jacal surface structures, occasionally adobe and/or slab-lined; small single story masonry pueblos; black-on-white ceramics; cranial deformation |
| Great Pueblo<br>AD 1100-1300 | large, multistoried masonry pueblos; great kivas; diversity of black-on-white pottery; corrugated pottery; black-on-red and polychrome pottery |
| Regressive Pueblo<br>AD 1300-1520 | large pueblos with plazas and great kivas; elaborate polychrome and other painted types |

Table 21. Longacre's developmental chronology

| PHASE | DEFINING CHARACTERISTICS |
|---|---|
| Incipient Agriculturalists<br>AD 300-500 | preceramic; corn, beans, squash; shallow pithouses with storage pits; 2-4 houses per settlement; basin metates; oval manos notched projectile points |
| Initial Sedentary Agriculturalists<br>AD 500-700 | deeper and larger pithouses; 1-5 houses per village; random layout of houses; random distribution of sites; Lino Gray, Alma Plain, Kana'a Neck-Banded, San Francisco Red, Alma Incised, Alma Neck-Banded |
| Established Village Farming<br>AD 700-900 | large deep pithouses; 5-15 houses per village; more settlements in more diverse locations; clusters of settlements; Alma Plain, San Francisco Red, Woodruff Smudged, Forestdale Smudged, White Mount Black-on-White, Kiatuthlanna Black-on-White, Red Mesa Black-on-White |
| Beginning of Planned Towns<br>AD 900-1100 | above ground non-contiguous rooms; true masonry pueblos later in phase; kivas; 8-15 rooms per settlement; clusters of settlements focused on sites with great kivas; Brown Textured, Reserve Black-on-White, Snowflake Black-on-White; Wingate Black-on-Red |
| Established Towns<br>AD 1100-1300 | large masonry pueblos with kivas; great kivas; larger but fewer sites along major drainages; 3 to 50 rooms per site; Brown Textured, Tularosa Black-on-White, Houck, Querino, and St. Johns Polychromes |
| Large Towns<br>AD 1300-1500 | large (50-100 room) settlements; fewer settlements; settlements restricted to major drainages; several kivas per site; plazas frequent; Pinedale, Four Mile, Heshotautha, Kwakina, and Kechipawan Pinnawa Glaze-on-White |

Table 22. Kidder's Pecos chronology

| PERIOD | DEFINING CHARACTERISTICS |
|---|---|
| Basketmaker I<br>pre-200 BC | Pre-agricultural; pre-ceramic |
| Basketmaker II<br>200 BC-AD 400 | agriculture; atlatl; pre-ceramic |
| Basketmaker III<br>AD 400-700 | pithouses; slab-houses; plainware; early Black-on-White |
| Pueblo I<br>AD 700-900 | cranial deformation; neck-corrugation; above-ground masonry rooms; Black-on-White pottery |
| Pueblo II<br>AD 900-1100 | villages, corrugated pottery; Black-on-White, Red pottery |
| Pueblo III<br>AD 1100-1300 | large communities; diversity of ceramic traditions; art |
| Pueblo IV<br>AD 1300-1600 | contraction of settlement; disappearance of corrugated pottery |

Table 23. Gladwin's chronology

| PHASE | DEFINING CHARACTERISTICS |
|---|---|
| White Mound<br>AD 730-800 | below-ground pithouses, surface jacal rooms; Lino Gray, White Mound Black-on-White, Polished Red Ware |
| Kiathuthlanna<br>AD 800-870 | major features added to pithouses; surface rooms; kivas; Kiatuthlanna Black-on-White, Lino Gray, Polished Red Ware neck-banding |
| Red Mesa<br>AD 850-930 | surface houses of adobe and wattle and daub; kivas; Red Mesa Black-on-White, indented corrugated |
| Wingate<br>AD 930-1000 | true masonry, multi-room surface structures; kivas; Gallup Black-on-White, Wingate Black-on-Red, gray indented corrugated |

Wasley and Gumerman and Skinner schemes, it is unclear precisely what evidence was used in adjusting phase boundaries. Rinaldo gives no dates, but simply describes equivalents to the Pecos chronology. One element of the Wasley chronology deserving note is the effort to separate sites showing "Mogollon influence" from those that do not.

The majority of these chronologies, whether explicitly developmental or not, reflect an effort to define a linear sequence for the locality under investigation. The following patterns of change seem to underly basic understanding of the area: from aceramic to ceramic; from plainware to corrugated; from black-on-white to black-on red, yellow, orange to polychrome; from atlatl to bow and arrow; from simple shallow pithouses to large, deep, and complex ones; from the absence of kivas to their presence with the subsequent addition of great kivas; from simple jacal to complex masonry surface rooms; from small to large villages; from a random to a dense to a clustered settlement pattern, both within and between sites. While local variants of these sequences are clearly recognized, none of the efforts recognize a need for major revision of the fundamental aspects of the Kidder and Roberts efforts.

Linearity through time and homogeneity at any point in time (with the recognized need to identify outside "influences") have been the guiding principles of chronology-building in the area.

Admittedly, many of the early efforts involved careful attention to tree-ring dates in justifying or modifying particular local sequences. However, in the interim, a conviction seems to have grown among archeologists working in the area that there are sound chronometric data that sustain the overall patterns of technological succession on which the chronologies are built. It is essential, therefore, to turn to these data and then consider their relationship to the chronologies.

## CHRONOMETRIC DATA

Four techniques have been used in obtaining absolute dates for sites in the study area; radiocarbon dating, tree-ring dating, archeomagnetic dating and obsidian hydration dating. Obsidian hydration dating has been applied exclusively in the western sector of the overview unit. Results to date (Findlow et al., 1975; Findlow and DeAtley 1978) are efforts to construct a curve for the area and have not yet provided meaningful determinations for sites not dated by other techniques. Archeomagnetic dates are available only for Hay Hollow Valley. Thus, the majority of the absolute dates are either tree-ring or radiocarbon dates. Available dates are listed in Tables 26 through 29. I do not believe that these lists are complete. The existing literature contains references to determinations that were made, the specific results of which are unreported. Similarly, there are, to my knowledge, more dates than have been reported in the published literature. Nevertheless, the determinations in these tables represent the vast majority of absolute dates available at present. A number of conclusions can be reached using these data.

In order to make statistically acceptable inferences about sites, a population of dates is required. One may take as a minimum roughly fifteen observations for any two populations (sites, areas) that are to be compared. Using this criterion, there are only 10 sites in the entire study area with a large enough population of dates. One of these sites is dated by radiocarbon, the remainder by tree-ring. Of these 10 sites the majority are either very early or very late.

Only two well-dated sites fall in the time period between about AD 800 and 1250. Of these, one is sufficiently complex that there is not a well dated room or deposit

Table 24. Wasley's "Highway 66" chronology

| PHASE | DEFINING CHARACTERISTS |
|---|---|
| Lupton<br>?-600 AD | large shallow pithouses; slab-lined storage cists; Alma Plain, Lino Gray |
| La Plata<br>AD 500-700 | Lino Gray, early black-on-white |
| White Mound<br>AD 700-800 | deep pithouses with features (ventilators, benches, antechambers, etc.) White Mound Black-on-White, Lino Gray |
| Kiathuthlanna<br>AD 800-900 | Kana'a Gray, Kana'a Black-on-White, Kiathuthlanna Black-on-White |
| Red Mesa<br>AD 900-1000 | some masonry, but generally crude jacal walls; kivas; prepared floors; multi-room settlements; Red Mesa Black-on-White |
| Wingate Phase<br>AD 1000-1100 | masonry construction; linear, multi-room settlements; kivas; Wingate Black-on-Red |

Table 25. Rinaldo's chronology

| PHASE | DEFINING CHARACTERISTICS |
|---|---|
| Vernon Phase (Basketmaker II & III) | Alma Plain, Vernon Plain, Lino Gray, San Francisco Red, Reserve Smudged; Pithouse villages |
| Mineral Creek (Pueblo I) | Kiathuthlanna and Red Mesa Black-on-White, Alma and Vernon Plain, Reserve Plain Corrugated; pithouse villages, surface pueblos(?) |
| Pinyon (Pueblo II) | Snowflake, Reserve Black-on-White, Wingate Black-on-Red, Alma and Vernon Plain, Reserve Plain and Indented Corrugated, Gray Indented Corrugated; small surface houses, rectangular; coursed masonry |
| Montosa (Pueblo III) | Tularosa, Snowflake Black-on-White, Show Low Wingate Black-on-Red, Vernon Plain, Reserve Plain, Reserve Indented, and McDonald Corrugated medium size, course boulder masonry pueblos |
| Springerville | Polychromes, Wingate Black-on-Red, Tularosa Black-on-White, Reserve Plain and Indented Corrugated with more smudged interiors; large two or more story masonry pueblos |

Table 26. Gumerman-Skinner chronology

| PHASE | DEFINING CHARACTERISTICS |
|---|---|
| Black Creek AD 1-600 | aceramic or Adamana Brown; large shallow pithouses |
| Basketmaker III AD 600-800 | circular surface structures with prepared clay floors, brush superstructure; Lino Gray, Black-on-Gray |
| Pueblo I AD 800-900 | circular to sub-rectangular pithouses with major features (entry ramps, benches, etc.); Kana'a Black-on-White, Brown and Gray Wares |
| Holbrook Phase AD 900-1100 | shallow, rectangular pithouses with four-posts; clay and stone rectangular surface rooms; Holbrook Black-on-White |
| McDonald Phase AD 1100-1250 | shallow rectangular and square deep pithouses; rectangular surface rooms in blocks; kivas; plazas; Holbrook, Walnut, Padre, and Leupp Black-on-White |
| Tuwiuca, Homolovi AD 1250-? | large villages around plazas; kivas; great kivas; black-on-red, yellow, orange and polychrome ceramics |

Table 27. Dated sites from the Chevelon drainage (Estimated dates are AD unless otherwise indicated; radiocarbon dates are tree-ring corrected)

| SITE NUMBER | ESTIMATED DATE | CHRONOMETRIC DETERMINATION |
|---|---|---|
| 43 | 1200-1275 | 1160p-1219vv |
| | | 1163p-1240vv |
| 58 | 1050-1125 | 410±150 |
| 68 | 1200-1275 | 1240±50 |
| 96 | 1200-1275 | 1485±50 |
| 141 | | 910±90 |
| 185 | 1200-1275 | 1250±40 |
| 189 | 1050-1125 | 1125±50 |
| 193 | Desert Culture | 810 BC ± 170 |
| 316 | 500-800 | 660±50 |
| 343 | 1200-1275 | 640±260 |
| 345 | 1200-1275 | 1155±50 |
| 412 | 1125-1200 | 1104fp-1195vv |
| 457 | 1200-1275 | 1420±170 |
| 450 | 800-1000 | 1555±170 |
| 462 | 1200-1275 | 915±180 |
| 470 | 1050-1125 | 870±175 |
| | | 987p-1092+vv |
| 503 | 1200-1275 | 1238p-1281+vv |
| 516 | 1050-1125 | 1140±160 |
| 552 | 1125-1200 | 1325±120 |
| 553 | 500-800 | 1370±125 |
| 608 | 850-1000 | 810±130 |
| 634 | 1050-1125 | 1180±195 |
| 689 | 1125-1200 | 1112-1160vv |
| | | 1114fp-1192vv |
| | 1200-1275 | 1187-1262vv |
| 690 | 1125-1200 | 1110p-1198vv |
| 729 | 1125-1200 | 1210±150 |
| 731 | 1125-1200 | 970±165 |
| | | 1210±150 |
| | | 1410±150 |
| | 1200-1275 | 1197-1274vv |
| 734 | 1200-1275 | 1112p-1191vv |
| | | 1115p-1201vv |
| | | 1111p-1224vv |
| 900 | 1200-1275 | 780±175 |
| | | 1115fp-1239vv |

Table 28. Dated Sites from Hay Hollow Valley (Dates are AD unless otherwise indicated; radiocarbon dates are tree-ring corrected)

| SITE NUMBER, NAME | ESTIMATED DATE | CHRONOMETRIC DETERMINATION |
|---|---|---|
| Broken K | 1175-1285 | 870±70; 1020±70; 1070±65; 1020±50; 1260±115; 1210±110; 1275±105; 1230±120; 1250±115; 1230±110; 1208p-1259vv |
| Carter Ranch | 1100-1200 | 1071p-1118r; 1059p-1116c; 1043p-1130vv; 1026p-1142v; 1051-1156v; 1020±60; 1180±70; 1180±70 |
| Connie | 300-600 | 285±105; Archeomag.: 650±31; 690±24 |
| County Rd. | Desert Culture | 1300 BC ±75; 410 BC ±70; 40 BC ±95 |
| Country Rd. Canal | 1000-1300 | 1390±95 |
| Hay Hollow | Desert Culture | 23 radiocarbon dates ranging from 470 BC to AD 305 |
| Hay Hollow Canal | 1000-1300 | 1095±100<br>1355±105 |
| Gurley | 500-750 | 675±95; 615±145; 525±65; 1000±110; Tree-ring: 766?; 726? |
| Joint | 1000-1300 | 48 tree-ring determinations ranging from 1188vv to 1255vv; strong cluster 1240-1250 |
| Kuhn | 200-700 | 1360±105<br>1520±95 |
| Swannie | 1200-1300 | Archeomag.: 1185±37; 1185±41 |
| Webb Tank | 700-900 | Archeomag.: 760±22; 670±49; 800±22 |
| 83 | 1100-1300 | 990±85 |
| 137 | 500-700 | 780±95 |
| 186 | 500-700 | 640±120 |
| 195 | 1000-1200 | 1215±85 |
| 196 | 1100-1300 | 745±90 |
| 199 | 600-750 | 990±140 |
| 201 | 1100-1200 | 1360±90 |
| 511 | 1200-1450 | 1030±80 |
| 530 | 600-700 | 260±100 |

Table 29. Dated Sites from the Houck-Lupton area (all dates are AD)

| SITE | ESTIMATED DATE | CHRONOMETRIC DETERMINATION |
|---|---|---|
| Allentown | unknown | ca. 130 tree-ring dates ranging from 775vv to 1015vv; clusters ca. 850 and 950-1000 |
| White Mound | 730-800 | 28 tree-ring dates from 675r to 768v. cluster at ca. AD 730 |
| Wide Ruin | unknown | ca. 260 dates 1119vv to 1282v; cluster at about AD 1276 |
| NA 7295 | 500-700 | 6 tree-ring dates from 802-804 |
| NA 7298 | unknown | 17 tree-ring dates from 532vv to 1123vv clusters at ca. 500 and 1123 |
| NA 7299 | 500-1100 | 17 tree-ring dates from 990vv to 1119vv clusters ca. 990, 1010, 1116 |
| NA 8038 | 900-1100 | 9 tree-ring dates from 914vv to 942v |
| NA 8039 | 900-1100 | 6 tree-ring dates from 1087vv to 1115r; cluster at ca. 1115 |

Table 30. Dated Sites from the remainder of the overview unit (Radiocarbon dates are tree-ring corrected; dates are AD unless otherwise indicated)

| SITE NUMBER | ESTIMATED DATE | CHRONOMETRIC DETERMINATION |
|---|---|---|
| Beach Sites | Desert Culture | 1300 BC ±60 |
| Chilcott | 900-1100 | 1170±80 |
| Coyote Creek Pueblo | 1150-1300 | tree-ring dates cluster at 1174-1194; range from 1174-1280 |
| Coyote Creek-3 | unknown | 7 tree-ring dates from 1012vv to 1119vv |
| Coyote Creek 3-11 | unknown | 9 tree-ring dates from 967vv to 1101vv |
| Four Mile | unknown | 1143fp-1214vv |
| Hooper Ranch | 1200-1375 | 1220±60<br>1380±65<br>1085±80 |
| Mineral Creek | 1000-1200 | 730±55<br>950±50 |
| P:7:1 | unknown | 2 tree-ring dates 1195vv-1200vv |
| P:12:6 | unknown | 4 tree-ring dates 932vv-938vv |

Table 30 (continued)

| | | |
|---|---|---|
| Pinedale | 1100-1300 | ca. 80 tree-ring dates ranging from 1068vv to 1378vv; cluster at 1275-1325vv |
| Rim Valley | 1175-1275 | 1070±50 |
| Show Low | 14th century | 500+ tree-ring dates from 1118vv to 1384vv cluster at 1335-1384vv |
| Table Rock | 1300-1450 | 1335±55<br>1235-1346vv |
| Tumbleweed | 300-500 | 223±50 |
| CMNA#30 | 600-800 | 750±55; 860±55; 940±55; 14 tree-ring dates from 776vv to 822vv; cluster at 800-820 |

from it; once the overall dates are broken down by component, their number is inadequate. Thus, the existing determinations are satisfactory only for the purpose of drawing broad contrasts between the beginning (aceramic, plainware, pithouse) and end (large pueblo, polychrome) of the sequence. The majority of sites date between these extremes and cannot be represented by well-dated sites at present.

Some of the sites were dated using ceramic seriation or other techniques prior to absolute determinations and others were not. In the case of those sites that were dated using other criteria (see Tables 22 through 25), the probability is about .70 that the absolute date falls within the range established on the basis of architecture/artifacts. This figure is far too low to support the argument that existing typologies are adequate for dating sites. Moreover, the figure would be far lower were it not for the 150 to 200 year range used in approximating dates on the basis of artifactual criteria. Generally, when sites are dated to a period of 100 years or less, the probability is very high that absolute determinations will fail to fall within the accepted range.

Even if one takes what are supposed to be relatively clear temporal manifestations such as aceramic pithouse villages or large late sites, the range of dates is high. Aceramic pithouse villages date from 400 BC to about AD 300. This figure would be far higher were it not for the fact that some investigators have rejected radiocarbon determinations for such sites on the ground that they were "too late." Large late sites could be as early as AD 1100 and as late as AD 1400. In two areas (Chevelon Drainage, Hay Hollow Valley) there are plainware pithouse villages that date to this same time period.

In summary, there are currently absolute dates for far fewer than 1% of the sites in the study area. These dates suggest a far more complex pattern of distribution of both architecture and artifacts than linear chronologies allow. While it is possible that more dates would support the efficacy of these chronologies, existing dates do not. These dates suggest a very uneven distribution of people over the study area at any one time and that the material items possessed by contemporaneous peoples was highly diverse.

## CHRONOLOGIES AGAIN

That absolute dates fail to support the chronology that has been used in the overview area should not be a surprise. In fact, if one carefully scrutinizes the chronologies themselves their inadequacies are obvious. Take Breternitz's (1966) tree-ring dated ceramic types, the most specific of the chronologies, as an example. If one studies the dates in Tables 9 through 13, a number of conclusions are evident. First, for the majority of types the span of time assigned is so long that it is of limited utility for dating purposes. Second, there are substantial conflicts between the "indigenous" and "trade" dates for a large number of

types. Finally, there were time periods when only a few types were present and others when many were present. Table 26 illustrates this problem for the case of Black-on-white types. Prior to AD 800, most ceramic types were of such longevity that their occurence on a site specifies very little. After AD 800, the longevity of types decreases dramatically. What is not evident in the table is that after this time period the spatial area over which the types occur also decreases dramatically. Thus, the distributions of types are highly uneven temporal indicators.

Given these problems with absolute dates, it is best to consider the chronologies in a very much broader frame. If one asks what characteristics are common to them, other than the linear succession of technologies noted earlier, a number of conclusions can be reached. First, some time around the time of Christ, some populations in the study area began to make and use ceramic artifacts. Yet, from the time of Christ until about AD 700 there is little that is definitive about the artifactual inventories in the area; few temporal boundaries are agreed upon. Most chronologies do, however, note a break at about AD 700. From this date until AD 900 many breaks are noted suggesting that this period was one during which a great diversity of changes in technological behavior and organization were occurring. Subsequently, most of the chronologies seem to agree on breaks at about AD 1100 and AD 1300, the former corresponding to the advent of large masonry pueblos and the latter to a period of abandonment or greatly decreased population. Yet, to take even these dates as watersheds applicable to the majority of peoples living in the area would be a mistake. At this point, one can only note the need for far more sophisticated chronometric studies.

Table 31. Black-on-White types present at fifty-year time intervals. Dates are "best" dates from Breternitz (1966)

| DATE (AD) | TYPES |
|---|---|
| 600 | Chapin, Lino, La Plata |
| 650 | Chapin, Lino, La Plata |
| 700 | Chapin, Lino, La Plata |
| 750 | Chapin, Kana'a, Lino, La Plata |
| 800 | Chapin, Kana'a, Lino, La Plata |
| 850 | Kiatuthlanna, Lino, La Plata, Piedra |
| 900 | Kiatuthlanna, Piedra, Red Mesa |
| 950 | Escavada, Red Mesa |
| 1000 | Escavada, Gallup, Red Mesa |
| 1050 | Chaco, Escavada, Gallup, Mesa Verde, Puerco, Red Mesa |
| 1100 | Black Mesa, Chaco, Escavada, Gallup, Holbrook, McElmo, Mancos, Mesa Verde, Padre, Puerco, Red Mesa, Snowflake, Sosi, Reserve, Walnut |
| 1150 | Black Mesa, Dogozhi, Flagstaff, McElmo, Mancos, Mesa Verde, Padre, Snowflake, Sosi, Tusayan, Walnut |
| 1200 | Dogozhi, Flagstaff, Kayenta, McElmo, Mesa Verde, Padre, Snowflake, Tusayan, Walnut |
| 1250 | Flagstaff, Kayenta, McElmo, Mesa Verde, Tusayan, Walnut |
| 1300 | None |

# EVOLUTIONARY PATTERNS

The discussion to this point has been heavily particularistic. Detail was necessary in order to convey a sense of the specific items of information we now possess, major hypotheses that have been tested, and alternative methodologies that have been employed. Now the focus shifts to a summary of some of the broader patterns of organization and change that were characteristic of the overview unit prehistorically. The discussion is far more speculative, and yet it remains a summary of what I think we know. Analytical strategies that will improve our understanding of the region's prehistory are considered in later sections. In this one, demography, productive strategies, and organizational strategies are considered.

## DEMOGRAPHY

With the possible exception of the Black Mesa area, no region of the Southwest has seen a more extensive set of demographic analyses than the Little Colorado overview unit. While the results of these efforts are by no means perfect, they do suggest significant patterns of variation both through time and from locality to locality within the study area.

Longacre's (1976) was the first effort to describe the pattern of population growth for the study area. He used survey information for the Upper Little Colorado area that he had collected along with Rinaldo. His reconstruction is a plot of change in the number of sites and the mean number of rooms per phase, using his own phase system as described earlier. He concluded that population in the Upper Little Colorado area began to increase somewhere between AD 500 and 700. A peak was reached between about AD 1200 and 1300, with population declining to zero during the next 200 years.

Plog (1974) focused specifically on the demographic record for Hay Hollow Valley. He used room counts per 50-year period, modifying the observed room numbers to take into account the probability of site occupation and changing ratio of habitation to storage rooms. He found evidence of an initial period of population increase peaking at about AD 450, after which population declined. A second episode of increase began at around AD 700, peaking at about AD 1150. This peak was followed by the rapid abandonment of the Valley. Differences between Plog's and Longacre's reconstructions reflect both the specific local conditions of the valley, where more early sites seem to occur, and differences in dating.

Zubrow (1975) reanalyzed the Hay Hollow data using the total number of habitation rooms. His reconstruction more closely approximates that of Longacre, lacking the early epoch of increase noted by Plog. Zubrow's methodological discussion is sketchy and it is impossible to resolve the differences between his reconstruction and Plog's. F. Plog (1975a) subsequently constructed population records for the Purcell Larson area showing a generally similar pattern to those of Longacre and Zubrow. Lightfoot (1978d) has discussed the pattern of population growth in the vicinity of Springerville. Basically, human occupation of this area appears to be late, no earlier than about AD 1050-1100. The local increase is rapid with a few groups remaining in the area until the fourteenth century.

Orcutt (Cauthen 1972, Orcutt 1974) reworked the Hay Hollow Valley, Purcell-Larson and Chevelon data in an effort to identify some of the methodological problems associated with population reconstructions. Using Hay Hollow data, she demonstrated that, if one assumed that sites grew slowly and declined rapidly (as opposed to the even growth rates assumed by F. Plog 1974), a substantially different curve was generated. Prior to about AD 900, her reconstruction is characterized by a series of short fluctuations. After this date, the epoch of growth and decline she describes is more rapid than that noted by Plog. Her analysis also showed that there are separable elements of the growth process that result from increased numbers of sites and increased site size. The major growth epoch is associated with an increase in site size and may, thus, represent change in organization or length of site occupation rather than increased numbers of humans.

Orcutt has also attempted population reconstructions based upon a diversity of different indicators: number of sites, site size, number of rooms, aggregate floor

area, artifact density, and total number of artifacts. While she found that the curves generated using these different data bases are highly correlated, there are enough differences to cause substantial concern. Of particular interest is a far greater than expected increase in artifact densities and counts toward the end of the sequence, which may again suggest organizational change or change in the length of site occupation. Orcutt's final (1974) study includes an insightful summary of methodological difficulties that must be overcome if our reconstructions are ever to attain a desirable level a reliability.

While all of the reconstructions just mentioned are speculative, they suggest a number of conclusions concerning change in human numbers through time. First, there is little indication of other than episodic utilization of the study area until about the time of Christ. Second, there may have been a population increase culminating at about AD 450. Third, all lines of evidence suggest a major increase in population between about AD 900 and 1150. Fourth, further analysis is required to be certain that this last increase is the product of a real increase in human numbers rather than organizational change or change in the average length of site occupation.

Spatial variation through the study area is much less well understood. It is evident, however, that drastic differences in the time at which population peaks occurred in particular areas. To date, there has been only one attempt to understand the spatial dynamic of changing human numbers, that of Slatter.

Slatter (1973, 1979) has assessed the relationship between climatic variation and population shifts in the overview unit. Using dendroclimatological records, he noted: (1) years in which tree-ring width (inferentially, rainfall) was more than one standard deviation below normal, (2) sets of 3 years in which tree-ring width was more than one standard deviation below normal (since the 1 to 2 year surplus produced by modern Western Pueblos would have been exhausted during this period), and (3) sequences of drought lasting several decades. This record was then compared with variation in room counts through time for (a) the Chevelon drainage and (b) the Purcell-Larson locality within it. A strong negative correlation between population and rainfall occurred for the drainage, while that for the locality was strongly positive.

Slatter sought to resolve this problem by assessing the possibility that the environmental characteristics of the locality were different from those of the drainage as a whole. He noted variation in the amount of land with a slope of less than 8%, land profile, relief, and elevation throughout the drainage. A cluster program was then used to define five different landform types, four of which were judged to be marginal for farming when precipitation, temperature, and local soil alkalinity were investigated. The area with the best growing conditions was determined to be that in which the Purcell Larson locality occurred.

Reanalyzing the data, he found that the positive correlation between rainfall and population in the Purcell Larson area was a product of a tendency for prehistoric peoples to leave more marginal areas and move into this area during drought periods. Slatter also notes that the overall magnitude of population movement/displacement was a reflection of the total number of droughts and dry years during a period of several decades and that the end of the occupation of the drainage was a period during which both three year droughts and dry years were especially frequent. Subsequently, Slatter extends his analysis to other areas of the Southwest where high quality survey data are available and showed that similar patterns occur there. In general, his results are very close to those of Euler et al., (1979).

Providing a specific definition of a "marginal" as opposed to a "non-marginal" area is, of course, a problem. Zubrow (1975) undertook an exhaustive analysis of the carrying capacity of microhabitats in Hay Hollow Valley and was able to demonstrate major differences. However, the zones that he studied lie in such close proximity to one other that all would have been easily reached by the inhabitants of the vast majority of sites. I suggest that the juniper-pinyon woodland probably represented the optimal habitat prehistorically. In respect to agriculture, the best balance of temperature and precipitation occur at elevations where the woodland predominates. In respect to hunting-gathering, this biome contains most of the resources of adjacent

ones in addition to its own unique resources. Nevertheless, there is substantial variation in the extent to which this habitat was used both spatially and temporally. Similarly, there are areas well outside of the current, and any reasonable prehistoric, limits for the woodland zone. Since the majority of intensive surveys to date have been done in woodland areas, the pattern of distribution of population may differ in significant ways from what appears to be the case at present.

No analysis undertaken for the overview unit has utilized any sophisticated strategy for separating the effects of natural population increase from those of migration. Interpreting the overall demographic history of the area will be impossible until such studies are undertaken. Similarly, there has been no effort to test major hypotheses dealing with variation in human numbers either spatially or temporally. Such efforts will need to take a number of factors under consideration. First, the initial distribution of human occupation of the area probably had an effect on the distributions for the next several centuries. That is, given that the evidence of early occupation is not even throughout the study area, one might anticipate growth from a number of early nodes. Second, the effect of increased sedentism on population distributions requires investigation. If the growing population of the area is a product of an increased birth rate rather than migration, evidence of increased sedentism and its correlation with increasing numbers of humans becomes critical. Also, there appears to be a correlation between the major epoch of population increase in the area and intensified agricultural practices. While the ability of intensified practices to succeed in the long run in the overview unit is dubious, short term success in resource production may have fueled population increases. Finally, it is not beyond the realm of possibility that the population of the study area was relatively stable after about AD 700. The apparent increases may simply reflect the movement of people in and out of marginal and nonmarginal environments and changes in site size and site organization.

## PRODUCTIVE PROCESSES

Probably because so much of the emphasis on research in the Southwest during this century has been on excavation, much existing intepretation tends to emphasize the autonomy of individual settlements. This perspective is one that had been subject to increasing question in recent years. The contrasting viewpoints are perhaps most evident in the works of Leone (1968) and S. Plog (1980b).

Leone's dissertation was an analysis of the relationship between economic and social autonomy. His basic assumption was that the adoption of agricultural subsistence strategies provided local peoples with a means of achieving independence at the level of individual villages or settlements. His effort is intended to demonstrate, using ceramic styles, that increasing social autonomy accompanied this productive change. That either agriculture or ceramic production might have been handled by other than autonomous units is simply not considered.

S. Plog has focused on patterns of ceramic production within the Plateau Southwest in considering the question of autonomy. He basically questions the notion of autonomy, suggesting that the preponderance of evidence supports a pattern of ceramic production in a few loci with subsequent widespread exchange of the craft product.

In retrospect, there is little about either the environment or the probable demographic patterns in the study area that lend credence to a notion of autonomy. The major characteristic of the environment is extreme spatial and temporal variation in the distribution of all resources and in climate. Similarly, population densities in the area were low. Following Wobst's discussion of "minimum equilibrium size," the smallest groups necessary for a population to reproduce itself, interaction among widely dispersed peoples would have been necessary to ensure survival. Thus, whether one is considering the exchange of mates, exchange of resources, exchange of information concerning the availability of resources, or the exchange of finished goods, available evidence increasingly supports the conclusion that autonomy within the study area was quite limited. The reasons for making this claim will be clarified by reviewing aspects of our current understanding of a variety of productive alternatives.

The initial occupants of the study area,

during the PaleoIndian, Desert Culture, and Basketmaker periods were almost certainly either nomadic or semi-sedentary. It is tempting to view the subsistence strategy of such groups as one that requires little intergroup contact. Such a conclusion might be correct in a highly equable environment with an even spatial and seasonal distribution of resources. However, in an environment such as that of the study areas with marked temporal and spatial variation in resource availability, autonomy at the family level would be close to suicidial. A network for monitoring information on the availability of resources within particular localities would have been essential. If group size was small, interfamilial contacts would also have been essential in order to maintain a viable human breeding pool. Hoffman's (1974) analysis suggests that quite discrete resource sets would have been available given the particular environmental conditions of adjacent summers and winters. This observation only strengthens the suggestion that successful groups in the area probably managed on the basis of a substantial exchange network. In this sense, the absence of autonomy was essential to survival.

The notion that agricultural subsistence strategies would have increased the extent of autonomy is essentially derived from Leone's (1968) study. His reasoning stems from the common sense notion that people could have planted resources in immediate proximity to their domiciles rendering them at least somewhat more autonomous. Such an argument fails, however, to take into consideration the likelihood that the crops in any given field would have produced a harvest during a particular growing season. Given the substantial evidence of differential distributions of temperature and rainfall conditions developed earlier, the likelihood of all fields producing in all years, or even most fields in most years, was minimal. The adoption of intensified productive strategies (irrigation, terracing, and gridding) would have accentuated the problem. While these strategies improve soil and increase the precipitation "harvest," they also increase the dependence of local peoples on a favorable climate at a highly specific location.

Furthermore, more intensive strategies also require the allocation of labor and water and soil situations among competing groups which decreases the extent of autonomy. In summary, a successful agriculturalist in the study area would have had a considerable interest in the maintenance of at least reciprocal ties with nearby groups to ensure a backup in years when local crops failed. Similarly, during the period when agriculture was a common strategy, population densities were still not sufficiently high to decrease dependence on a sizeable inter-community network in order to ensure a viable population of mates.

The discussion of the availability of fuel and fuel needs in an earlier section suggests another basis for questioning the autonomy of local groups. After the time of Christ, it appears likely that the inhabitants of the larger sites would have had fuel needs that would have impinged on those of surrounding groups. After about AD 900, population density is sufficiently high that a widespread problem with fuel is possible. It seems probable that exchange relationships sufficient to distribute available resources existed in many areas after this time.

A number of different lines of evidence bearing on the production of craft goods have been or will be developed. Even in the case of a resource as simple as lithic raw materials, no compelling case can be made for local independence. The majority of raw materials used by peoples in the study area were locally available, and there is no time period during which materials that would have required transport from distant sources are not also in evidence.

While obsidian is the foremost instance of such a resource, petrified wood and basalt are others. Certainly, one cannot argue that such resources were essential, that the viability of local groups would have failed without them. However, the very fact that evidence of such widespread exchange exists shows a substantial commitment to obtaining "preferred" raw materials even if these came from distant sources.

Local specialization in the production of craft goods is suggested by evidence from Broken K (Longacre 1964) and Coyote Creek Pueblos (DeGarmo 1975). However, the most compelling information is that generated by petrographic and other detailed analyses of ceramic artifacts. If, as has been typically assumed, ceramic artifacts were being

produced in every, or even the majority of, contemporaneous settlements, one would expect at least a normal distribution (and more likely a highly disparate distribution) of technological characteristics. Recent analyses suggest the opposite; many ceramic types are sufficiently homogenous in their technological characteristics that only one or two productive centers are suggested. For the majority of types, no more than a few production centers are suggested.

The alternative is to believe in a highly regular and rigid system of communication and enforcement that standardized the product of the discrete producers living in individual villages. Such an assumption is unreasonable as it requires postulating an even higher degree of organization than its alternative. Certainly much remains to be known of the number and location of such centers. However, it is no longer reasonable to believe in village level ceramic production; the issue is one of learning more about the productive centers.

Certainly, I do not intend to espouse the notion that the inhabitants of the study area were, in any sense, full time craft or productive specialists. Available evidence does not suggest a pattern on the level of those of state organized societies. However, the existence of some degree of specialization resulting in a substantial degree of interdependence between inhabitants of different sites and localities now seems clear. Further, it is not beyond the realm of possibility that specialization was far more pronounced than available evidence suggests. Our poorest evidence of specialization pertains to food resources. And, given the great environmental diversity of the study area, it is in respect to these resources that it is easiest to imagine significant differences in the productive foci of different settlements and localities.

## ORGANIZATIONAL PATTERNS

None of the preceding should be construed as an argument for large and complex organizational entities in the prehistoric Southwest generally or in the overview unit specifically. While I believe it is likely that such organizations did exist at some times and in some places, my intent has been to express the need to look beyond narrow notions of village autonomy and to consider the multiple levels of organization in which prehistoric individuals participated. Varying degrees of independence and interdependence existed at each such level.

It would be pointless to even consider the possibility that the household was not an important organizational entity in the study area since households are organizationally significant in virtually every area of the world. Moreover, the fact that site size in the area approximates two or three rooms on the average suggests that the household may have been the very most typical residential unit at most times and in most places in the study area. Meals and the acquisition of basic local raw materials, were likely the exclusive domain of households. Productive activities were less likely so, although some simple stone tool items (chipped stone artifacts, for example) were likely household products. Similarly, some specialized products may have been made in specialized households. Nevertheless, it would be, on balance, a mistake to see the household as a self-sufficient unit.

Sites or settlements are a second level of organization. As noted above, most sites in the overview area are sufficiently small that they most probably were the abode of a nuclear or extended household. However, at all periods there appear to have been sites that were larger, possible central places in regional or local settlement systems.

Of particular importance is the observation that at any time period even the largest of sites in the study area were quite diverse in respect to their spatial organization. Large pithouse villages are an example for which one may define a number of discrete settlement types. Gladwin's excavations at White Mound produced a description of one such type (1945). White Mound style villages are composed of three or more pithouses and sometimes a kiva surrounded by an arc of surface rooms. A village may consist of one or several such "cells." White Mound style villages occur from the very northern edge of the overview unit to within a few miles of the Mogollon Rim, and from the far eastern to the far western edge. Kiatuthlanna, White Mound, and Kana'a Black-on-white are typical in the painted ceramic inventory.

Adamana style villages typically lack painted ceramics but may be contemporaneous with White Mound ones. The Connie Site (Thompson and Longacre 1972) is an example. The site consists of 35 pithouses, 11 "smaller structures," 1 probable kiva, and 6 features, all bounded by a cobble wall. Crudely made brownwares (probably Adamana Brown) are typical of such sites in the study area. With archeomagnetic dates of AD 650 and 690, this site and others of its type would appear to be contemporaneous with White Mound style villages. While they do not appear to occur in the western-most sector of the overview unit, they occur periodically in the northern and eastern portions.

Along these at least relatively formally arrayed villages are others with an incredible diversity of house types including combinations of above and below ground houses, circular and rectangular houses, etc. While these are in part contemporaneous with White Mound and Adamana villages, the possibility of episodic habitation is a clear one.

No effort is made here to offer an explanation for this diversity. The grounds for arguing that it is either exclusively spatial or temporal are weak. Thus, the possibility exists of some overarching pattern that unites sites in different segments of the study area. A similar problem exists in the case of pueblo architecture, although this variation is far more extensively described in the existing literature. Some pueblos have plazas, others do not. Some pueblos have great kivas, others do not. Some pueblos are compact and cellular, while others are linear or even circular. Examples of these different layouts can be found at a great diversity of times and places. A further problem in defining unitary architectural patterns is increasingly clear evidence of pithouse villages, at least some of which are sizeable ones, that are contemporaneous with the pueblos.

It is not currently possible to claim that the inhabitants of villages with similar layouts participated in important pan-regional organizational systems. It is however, interesting that both White Mound and Adamana style villages seem to share similar ceramic inventories. One wonders if the same might not prove true for pueblos were they considered from this perspective. An alternative interpretation is one that pertains to intra-village organization; sites have similar layout because their inhabitants had similar, but not necessarily linked, organizational patterns. Differential access of household groups to storage and ceremonial space appears to be evident in the arrangement of kivas and storage rooms with respect to habitation units. However, no exhaustive study that would clarify the extent of diversity exists at this point.

Even the change from pithouse to pueblo architecture has not been explicitly considered from an organizational perspective beyond some fairly obvious suggestions (cf. Plog 1974, Martin and Plog 1973). Yet, there are clear consequences of such change. First, in general, pithouses seem a far more adaptive living environment for much of the study area since it would have been possible to maintain a far more even temperature in these below-ground edifices at all seasons of the year. Thus, there must have been some important functional or sociological reason for shifting from the predominate use of one form to the other. And yet, the competing explanations are polar opposites. For example, one can note that the construction of a pithouse can be undertaken independent of the construction of other ones--they are discrete construction units. With pueblos, independence becomes more difficult since walls are built off of and, in some cases, support one another. Thus, the shift could be a counterpart of a change to a more tightly coordinated labor regime.

At the same time, the wooden construction materials required for pithouses are generally heavier and bulkier than those needed for erecting a masonry structure. Also, since an excavated pit can be badly damaged by rain, there may have been a greater need to construct pithouses within a short period. Given these last arguments, labor coordination may have been more of an imperative than constructing a masonry room which conceivably could have been done bit-by-bit over a long period. Thus, this architectural shift which can clearly offer major organizational clues, remains an enigma.

Given all of this diversity, the point seems clear that there were large central sites in the study area. The precise role that these played in regional and local

organizational systems remains to be specified. However, economic and political control seem likely possibilities.

Even in those times and places where large central sites were not common, there is good evidence for the existence of multi-site communities. In an earlier chapter, the reasons why multi-site communities linking peoples in diverse environmental zones would have made sense in the face of the environmental diversity of the study area were discussed. Distributions of ceramic and chipped stone artifacts lend credence to the possibile existence of such communities. That one can define communities with distinctive inventories of chipped stone raw materials is not a surprise since such a pattern might simply reflect local availability. That there should be commonalities in the imported raw materials does not sustain a propinquity argument, however. Similarly, the localities, or at least zones defined by the distribution of similar corrugated and black-on-white technologies, correspond reasonably well with localities defined by the use different chipped stone raw materials. Such a pattern suggests that the groups inhabiting such localities were cooperating in the procurement or production of a diversity of materials.

Undoubtedly, exchange was also an important component of such systems. Specific evidence of exchange was noted earlier. Similarly, there are likely caloric limits on the distance (ca. 30 kilometers; Lightfoot 1979) over which foodstuffs would have been exchanged. The range and magnitude of exchange that existed prehistorically within the area remains to be understood as does the manner in which it was organized.

Another concern for the study area is the distribution of material items associated with different of the classic culture areas described for the Colorado Plateau. If one equates Mogollon with Mogollon Brownwares, Sinagua with Alameda Brownwares, and Anasazi with Tusayan Graywares, then there are discrete sectors of the study area associated with each, although there is also considerable overlap. Basically, graywares are more common to the north, Mogollon Brownwares to the east and Alameda Brownwares to the west. At the same time, these ceramic distributions appear to be cross cut by highly varied architectural patterns. Whether the ceramic distributions represent any actual organizational entity seems problematical. At present it is more reasonable to regard them as commonalities that result from sharing among proximate local groups and in the distribution of craft products from centers.

Finally, there is suggestive evidence of exchange with far distant peoples. Plog, Upham, and Weigand (in press) have summarized the evidence for exchange between inhabitants of the plateau and mountainous areas and MesoAmerican groups. While it is unreasonable to view such exchange as the product of some singular organizational device, e.g., pochteca, it is now equally unreasonable to reject the growing evidence that spatially and temporally varied exchanges did occur.

On balance, much of the locational literature is suggestive of the maximum common level of organization in the area. Where locational studies have been done, the statistics suggest a pattern of dispersed site clusters (Upham 1980). These clusters are likely to have been the most important of the organizational levels above the household. I do not intend to deny the possible existence of major organizational centers. However, I suspect that such centers were highly episodic in space and time relative to enduring local site clusters. A variety of more abstract theoretical propositions which, given further research, may further inform some of these tentative conclusions are discussed in a subsequent chapter.

## FUTURE RESEARCH

Understanding of the early prehistory of the overview unit is hampered substantially by a paucity of pertinent information. Evidence of PaleoIndian peoples is minimal and ephemeral. PaleoIndian sites are such "rare events" or occurrences that designing a survey strategy specifically for the purpose of locating them would be virtually impossible. Virtually the only meaningful strategy that one might pursue would be survey in areas of high erosion.

Although they are somewhat more abundant, the same problem exists in the case of Desert Culture sites. However, survey and ancillary studies specifically for the

purpose of understanding this class of sites can be specified in somewhat greater detail. Although they have been heavily impacted by pothunting, rockshelters and caves in the western quarter of the overview area may still contain Desert Culture remains. Management, pending scientific use of the resource, is a high priority for these sites. Of particular importance are emphases on floral, faunal, and chronometric samples that seem to be abundant in such sites.

Open air Desert Culture sites may be a more common occurrence. This conclusion must remain tentative, however, until more satisfactory criteria for separating aceramic from preceramic sites are identified. If a large percentage of aceramic sites and aceramic low density artifact scatters prove to be Desert Culture sites, then these sites can be treated as a routine occurrence in most surveys in the area. The preservation of floral, faunal, and chronometric specimens in such sites is generally problematical. For the time being, the most profitable studies will focus on the provision of a clear criterion for specifying Desert Culture chipped stone tool inventories.

Varying somewhat from locality to locality, the abundance of sites is high from the centuries after the time of Christ. Generally, there is no difficulty in anticipating that sites of most time periods will be located in most large scale survey efforts. The principal problem in working with the chronology for these sites is the problematical manner in which chronometric specimens have been obtained. There is no question that sufficient determinations have been made to evaluate at least some chronological hypotheses in some areas. However, when the number of such determinations ranges from one to five hundred per site and the average site has less than a half dozen determinations, testing chronological hypotheses is an impossibility.

In recent years, it has also been common to submit samples for dating before analyses of other chronological data was complete. Since dating is invariably expensive, this strategy is not a judicious one. Effort should be spent in carefully framing a number of competing chronological schemes for the study area and localities within it. Samples can then be obtained from sites and components or strata within sites that are pertinent to testing at least one or two aspects of the pertinent propositions. Further development of archeomagnetic and obsidian hydration dating, since these strategies are less expensive, would also greatly increase our control of chronology.

Undoubtedly, archeologists working in the area will continue to use artifactual cross-dating. It is incumbent on such investigators to recognize the very preliminary state of existing ceramic chronologies. Unless great effort be spent in improving these, the boundary between fiction and fact will remain unknown for the overview area.

# CERAMIC TECHNOLOGY

## INTRODUCTION

Ceramic artifacts have been the major focus of analysis within the overview unit. Yet, current understanding of variation in ceramic technology is confused. The confusion is a result of analyses that have used drastically different typological systems and with relative insensitivity to consistency. Nevertheless, the analyses that have generated the confusion have created a depth of understanding of specific issues that is unequalled elsewhere in the world.

The most widely used typological system in the area has been that developed by Colton (1955a, b; 1956; 1958) and others working with him at the Museum of Northern Arizona. This system is based upon a set of roughly three dozen attributes. Types of that system that are commonly found in the overview area are as follows:

Tusayan Gray Ware
- Lino Gray
- Lino Black-on-Gray
- Kana'a Gray
- Coconino Gray
- Tusayan Corrugated
- Moenkopi Corrugated

Tusayan White Ware
- Kana'a Black-on-White
- Black Mesa Black-on-White
- Sosi Black-on-White
- Dogozhi Black-on-White
- Shato Black-on-White
- Tusayan Black-on-White
- Kayenta Black-on-White

Little Colorado Gray Ware
- Little Colorado Corrugated

Little Colorado White Ware
- Holbrook Black-on-White A,B
- Padre Black-on-White
- Chevelon Black-on-White
- Pinedale Black-on-White
- Walnut Black-on-White
- Leupp Black-on-White

Tsegi Orange Wares
- Tusayan Black-on-Red
- Tusayan Polychrome
- Kayenta Polychrome
- Jeddito Black-on-Orange
- Jeddito Polychrome
- Klageto Black-on-Yellow
- Klageto Polychrome
- Kin Tiel Black-on-Orange
- Kin Tiel Polychrome

Homolovi Orange Ware
- Homolovi Corrugated
- Homolovi Plain

Winslow Orange Ware
- Tuwiuca Orange
- Tuwiuca Black-on-Orange
- Homolovi Polychrome
- Chavez Pass Black-on-Red
- Chavez Pass Polychrome
- Black Axe Plain
- Homolovi Black-on-Red
- Black Axe Polychrome

Jeddito Yellow Ware
- Jeddito Black-On-Yellow

Alameda Brown Ware
- Rio de Flag Brown
- Angell Brown
- Sunset Red
- Kinnikinnick Brown
- Chavez Brown
- Grapevine Brown
- Tonto Red (Brown)
- Verde Red (Brown)

Cibola White Ware
- White Mound Black-on-White
- Kiathuthlanna Black-on-White
- Red Mesa Black-on-White
- Puerco Black-on-White
- Gallup Black-on-White
- Excavada Black-on-White
- Reserve Black-on-White
- Tularosa Black-on-White
- Snowflake Black-on-White
- Pinedale Black-on-White

Mogollon Brown Wares
- Alma Plain
- San Francisco Red
- Various Corrugated Types

White Mountain Red Wares
- Wingate Black-on-Red
- Puerco Black-on-Red
- Querino Black-on-Red
- St. Johns Polychrome
- Springerville Polychrome
- Show Low Polychrome
- Four Mile Polychrome
- Pinedale Polychrome

In general, differences in temper, surface treatment, and type of paint are the key attributes for defining painted wares. The typological differences within the wares are generally stylistic. The strength of this system is that it is based upon a set of attributes that are sensitive to the manner in which prehistoric potters would have manufactured a vessel. Also, it was developed under the auspices of a single individual and, therefore, the definitional consistency is substantial, if not absolute.

There are two weaknesses in Colton's system. Many of the attributes used to define a type are irrelevant for distinguishing different types. Also, definitions for some of the most common types in the overview area were never written because Colton had less familiarity with the ceramics of this area than of areas closer to Flagstaff. Detailed criticism of the approach is made in Hantman, et al., (in press). Major wares and types are shown in Figures 7 through 17.

Another typology is that used by the Chevelon Archeological Research Project between 1971 and 1978. This typology was developed explicitly to remedy some of the difficulties with the Colton approach. It is most basically a ware level system that is based upon readily observable temper, surface treatment and paint characteristics. This system and the manner in which its categories equate with those of the Colton system are shown in Table 32.

The strength of this system is that it is based only on attributes that are in fact necessary to distinguish between the categories. The pertinent attribute states form the name of the class. In one respect, the typology is also more consistent than Colton's; it defines differences within Cibola White Ware that are at least as great as the differences Colton used to separate the other major wares. The weakness of the typology is that it does not incorporate any attributes reflecting stylistic variation. As a result, stylistic information is lost.

One of the results of the intensive use of these systems in the area is a growing recognition of the problems that arise from the use of a typology that incorporates both style and technology into a single system. Implicitly, there is no reason to assume that style of decoration and technique of manufacture either reflect the same cultural processes or vary at the same rates.

Efforts to resolve conflicting aspects of the association of stylistic and technological attributes probably underlie the inconsistencies that have been identified in descriptions of ceramic variation in the area (Swarthout and Dulaney in press; Fish 1978; Hantman et al., in press; Sullivan in press). It is for this reason that Hantman, et al., (in press) and implicitly Sullivan (in press), advocate the use of discrete typologies for analyses of ceramic variation. This is not to argue that the existing typologies are not useful for ballpark communications about the nature of the ceramic materials that are the focus of a particular study. It does argue that most detailed inferences concerning prehistoric human behavior will require typologies that are sensitive to variation in each domain independently. For this reason, the following discussion focuses separately on style and technology.

## STYLE

Most of the studies of variation in ceramic design style have dealt with painted ceramics. These will be considered first. S. Plog (1976) provides a thorough discussion of the terms that have been used to describe variation, the approaches that have been used in the study area, and the problems that have arisen in particular approaches. He also summarizes a number of different approaches that have been used within the study area.

The earliest studies of stylistic variation presumed a typological system. Typical elements, motifs, and even "styles" were described for the major painted wares by Colton and others. While there are many comments on particular styles and their spatial and temporal distributions in the site reports of the study area, the earliest systematic effort to explicitly deal with style was Wasley's (1959) discussion of stylistic trends in Southwestern prehistory. He argued that one might best view the different major styles as horizon markers. Wasley's work was apparently discredited by Breternitz's study of the association between particular ceramic types and tree-ring dates (1966).

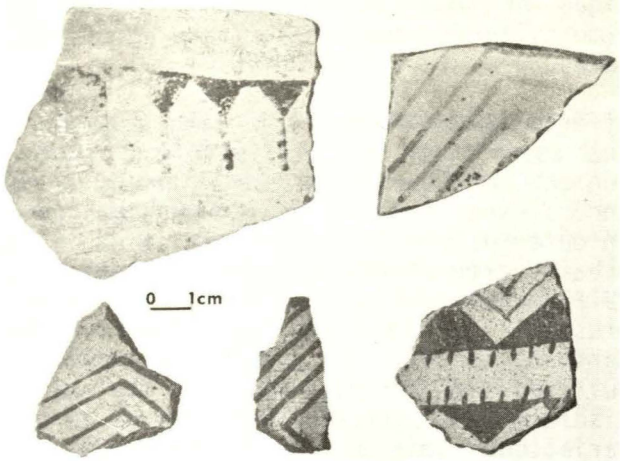



Figure 7. Lino-Kan'a style sherds.

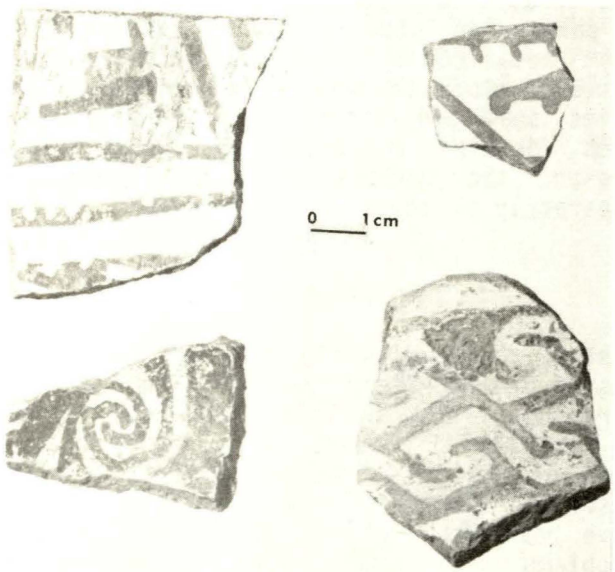



Figure 8. Black Mesa style sherds.

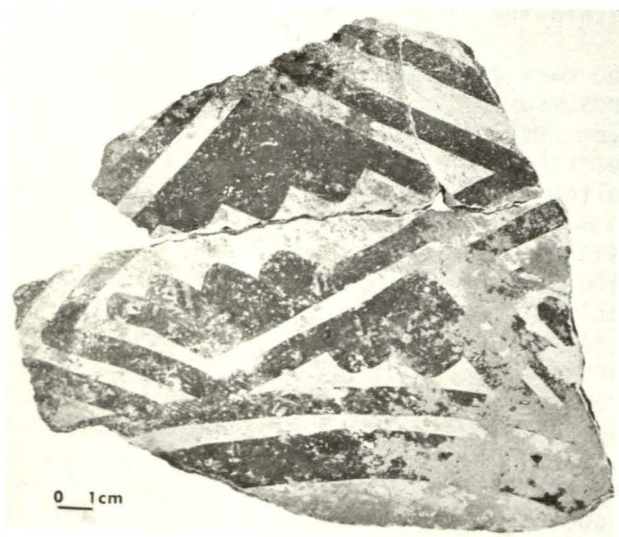



Figure 9. Sosi style sherds.

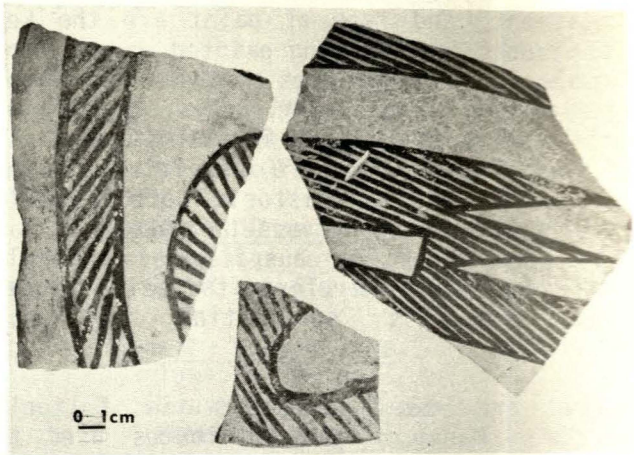



Figure 10. Dogozhi style sherds featuring typical parallel banded lines.

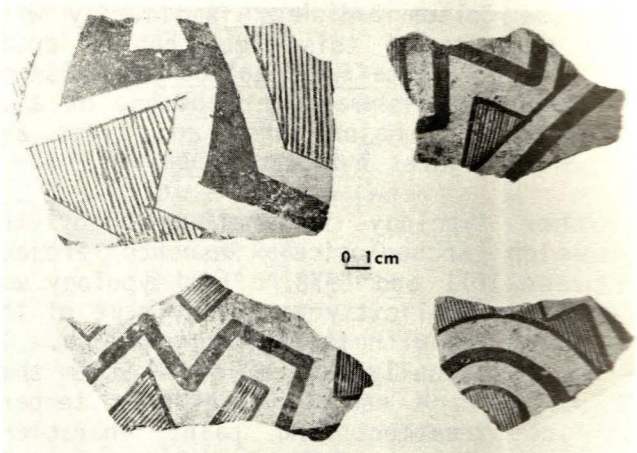



Figure 11. Tularosa/Reserve style sherds.

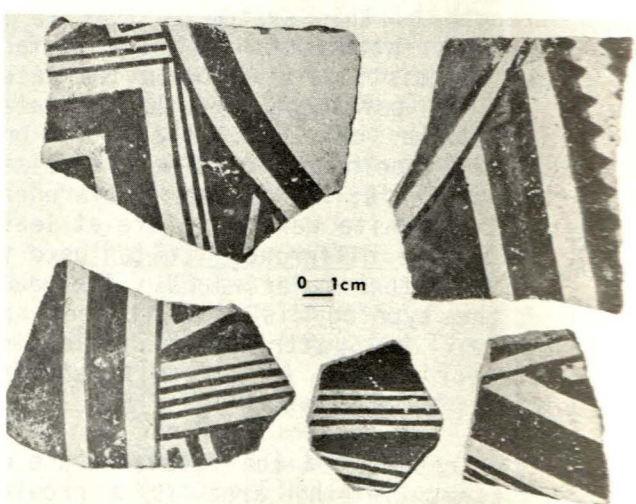



Figure 12. Flagstaff style. Sherds from the overview area representing the Flagstaff style.

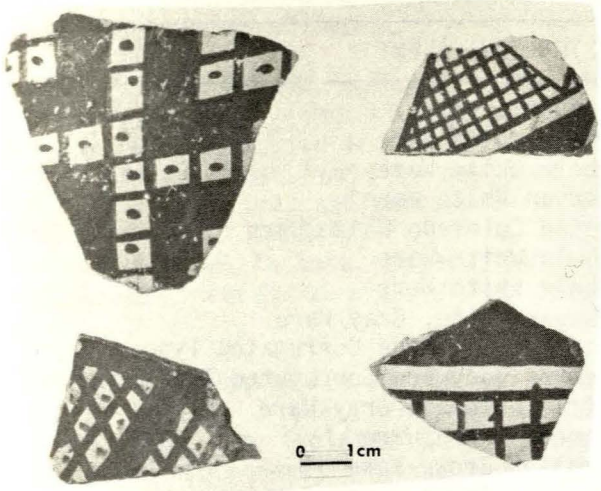



Figure 13. Kayenta style sherds.

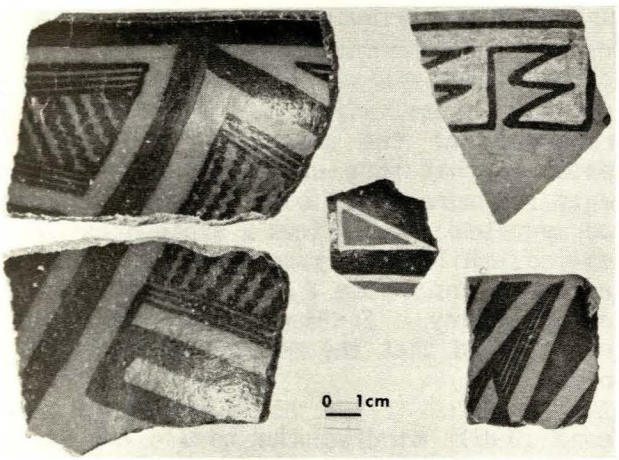



Figure 14. Polychrome sherds typical of the Little Colorado overview unit.

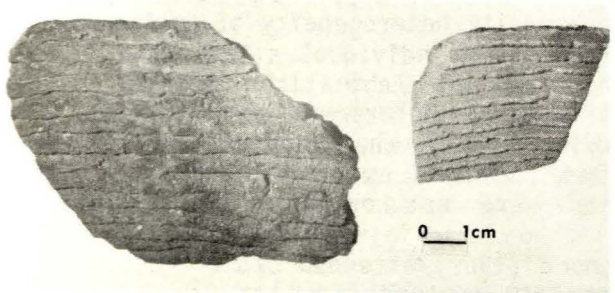



Figure 15. Banded ware.

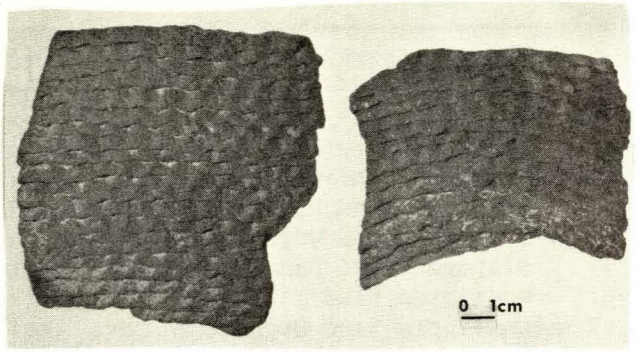



Figure 16. Indented Corrugated sherds.

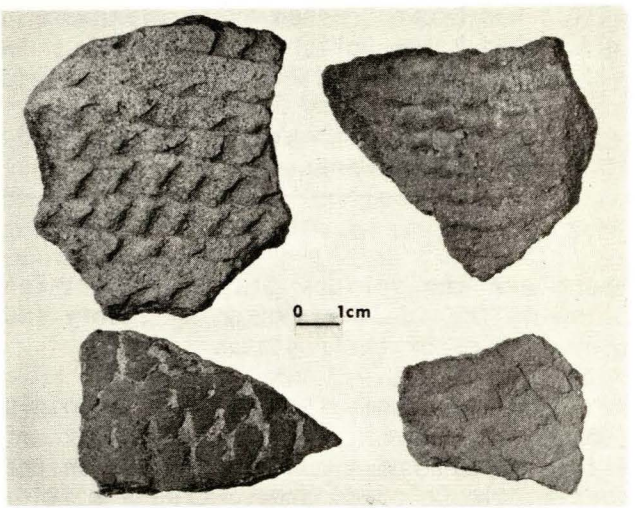



Figure 17. Obliterated Corrugated style sherds which are a variation of Corrugated style sherds illustrated above.

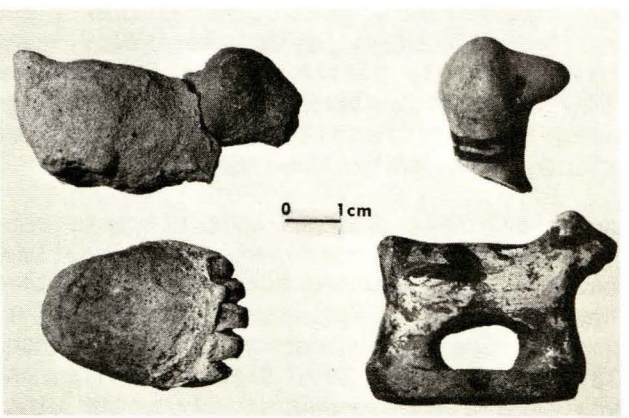



Figure 18. Ceramic artifacts.

In the early 1960s Longacre and others began to explore a theory of style based upon what S. Plog (1976) has termed "learning theory." This approach uses a series of assumptions, the most important of which is that daughter-potters learn design styles from mother-potters and that design styles will be localized within regions, localities, and even sites to reflect the prevailing matrilocal residence behavior of the Western Pueblo. S. Plog (1980a) has summarized the many criticisms of the theoretical assumptions underlying this approach. More important to this

Table 32. Ceramic Equivalencies for the Overview Unit

| CHEVLON ALPHABETIC TYPE | COLTON EQUIVALENT |
|---|---|
| Polished Gray Organic | No equivalent |
| Polished Gray Mineral | Cibola White Ware |
| Polished Sand Mineral | Cibola White Ware |
| Polished Sand Organic | Tusayan White Ware |
| Slipped Sherd Organic | Little Colorado White Ware |
| Slipped Sherd Mineral | Cibola White Ware |
| Unslipped Sand Mineral | Cibola White Ware |
| Unslipped Sand Organic | Tusayan White, Gray Ware |
| Red Brown Crushed Rock Corrugated | Mogollon, Alameda Corrugated Types |
| Grey Sand Corrugated | Tusayan Grayware Corrugated Types |
| Grey Sherd Corrugated | Little Colorado Gray Ware |
| Red Brown Crushed Crock Plainware | Alameda Brown Ware |
| Red Brown Polished Plainware | Mogollon Brown Ware |
| Red Brown Sand Plainware | Mogollon Brown Ware |
| Red Brown Sherd Plainware | No equivalent |
| Red Brown Volcanic Plainware | Alameda Brownware-Sunset Types |
| Grey Plainware | Tusayan Gray Plainware |

report are the various studies undertaken following the ideas of learning theory and an evaluation of their status today.

The first of the studies was Cronin's (1962), a ceramic design analysis of various types from a number of sites in the Upper Little Colorado area. Cronin's study was interpreted to indicate that the design style on different types at the same site were more similar than those on the same type at different sites. S. Plog (1978) has identified both statistical and empirical problems with the study, and argues that the variation described in the study reflects spatial and temporal differences between the sites to a far greater extent than any site-specific patterns.

Longacre (1964) drawing upon concepts used by Smith (1962), defined the "Snowflake School" of potters and three varieties that they produced. The three varieties in question are widely recognized as Holbrook Black-on-white, Reserve Black-on-white, and Snowflake Black-on-white. Given the widespread distribution of these types, it is dubious that they are distinctive products of a local school in the sense that Longacre envisioned.

Longacre (1964, 1970) also argued for localization of design traditions within particular rooms and particular areas of the burial ground at Carter Ranch Site and for sharing of design traditions among other sites in the vicinity of that one. A reanalysis of the data by S. Plog (1978) indicates that none of the pertinent arguments Longacre makes can be sustained when appropriate statistical procedures are applied. Hill (1970) constructs a similar argument for Broken K Pueblo, also in Hay Hollow Valley. S. Plog (1978) has again demonstrated that the results are questionable.

Leone (1968) studied the nature of interaction between sites in Hay Hollow Valley by evaluating color variation in plainware ceramics (Cohn and Earle 1967) and design variation on painted sherds (Howe, Menkes and Redman 1967). He evaluated the homogeneity/heterogeneity of collections of sherds from individual sites occupied over the span of habitation in the valley. While Leone interprets the variation as a reflection of changing village autonomy, other potential explanations for the variation were not evaluated (Tuggle 1970).

Connor (1969) extended Leone's analysis to the 14th century sites of Pinedale, Fourmile and Shumway in the surrounding area. Her preliminary analysis generated results similar to Leone's. A subsequent reanalysis (Tuggle 1970:75-76), however, showed that the degree of homogeneity characteristic of the sites did not change when the data from them were pooled.

Maley (1970) and Ester (1970) followed this same analytical tradition in regard to the distribution of ceramics in different room

types and site areas at the Joint Site and interaction between villages.

S. Plog (1976, 1977a) employed a multivariate approach to the study of design variation that attempted to isolate aspects of the variance that could be assigned to space, time, function, and exchange. While he argues that exchange is the most important of the factors, aspects of the variation are traced to each of the other factors.

Graves (1978) studied variation in White Mountain Redware styles throughout the overview area. He isolated both spatial and temporal components of the variation and argued for different contemporaneous areas of manufacture and distribution for different types.

Lightfoot (1981) has used design variation to argue for exchange between multi-site communities in the Pinedale area.

Hantman and Lightfoot (1978) have used metric attributes of design variation as a means of creating a chronology sensitive to short-term temporal variation. Their work strongly suggests that variations in line width and line spacing are the most sensitive temporal markers.

Hantman, et al., (in press) argue for a system of stylistic variation similar to that originally proposed by Wasley (1959) and resurrect his argument that the styles are horizon markers. This approach is illustrated in Figures 7 through 13. A similar system has been proposed by Sullivan (in press).

Studies of variation in plainware and corrugated ceramics are much less common. In addition to the studies associated with Leone's work that were mentioned earlier, Cook (1970) has described color variation in plainware ceramics, arguing again for socially patterned distributions. Rafferty and Brunson (1978), Sipe (1978) and Brunson (1979) had proposed design categories for corrugated ceramics based upon a statistical analysis of sherd attributes and have argued for a patterned and largely spatial distribution of the different classes used in the analysis (see Figures 16 and 17).

### Function

Function at this point, has been less thoroughly studied than either style or technology although there are implications for the study of both that derive from the reports of S. Plog (1977), Rudecoff (1975), and Lerner (1979a, b). Plog and Rudecoff described evidence indicating that there are substantial differences in the pattern of variation in bowls and jars. Bowl sizes are far more tightly clustered than are jars, although both distributions are unimodal. Significant differences in line size, type of hatching, design elements, and design composition between the two categories can be demonstrated. Thus, both spatial and temporal studies should control for functional variation. Hantman (1977) and Lerner (1979a, b) indicate that when materials are from spatially and temporally different areas, the problem may not be so extreme as when materials are from nearby sites. Further attention must be given to classes of ceramic artifacts other than containers and to reused artifacts (see Figures 18 and 20).

## TECHNOLOGY

As is the case with style, the earliest discussions of technological variation in ceramics occur in individual site reports and the first systematic discussion of the variation is in Colton's definition of various wares and types. Specific studies dealing with technological variation include the following.

Martin (1941) sponsored a study of 16 sherds of Alma Rough, Alma Plain and San Francisco Red from the SU site, just outside the study area in New Mexico. The study established that the types in question were commonly made with sand temper.

Martin and Rinaldo (1960) described the results of petrographic analyses of 80 sherds from the Table Rock Pueblo site near St. Johns. They note that sherd temper occurred in 30 Alma Plain specimens.

Martin, Rinaldo, and Longacre (1961) noted that 17 sherds from the Mineral Creek site and 26 from the Hooper Ranch site were analyzed petrographically. Sherd temper was not common in Alma Plain but was common in most painted types from these sites.

Longacre (1964) used the results of petrographic analyses of 20 black-on-white and black-on-red sherds from the Hay Hollow Site to argue that all the ceramics were made of the same materials and probably

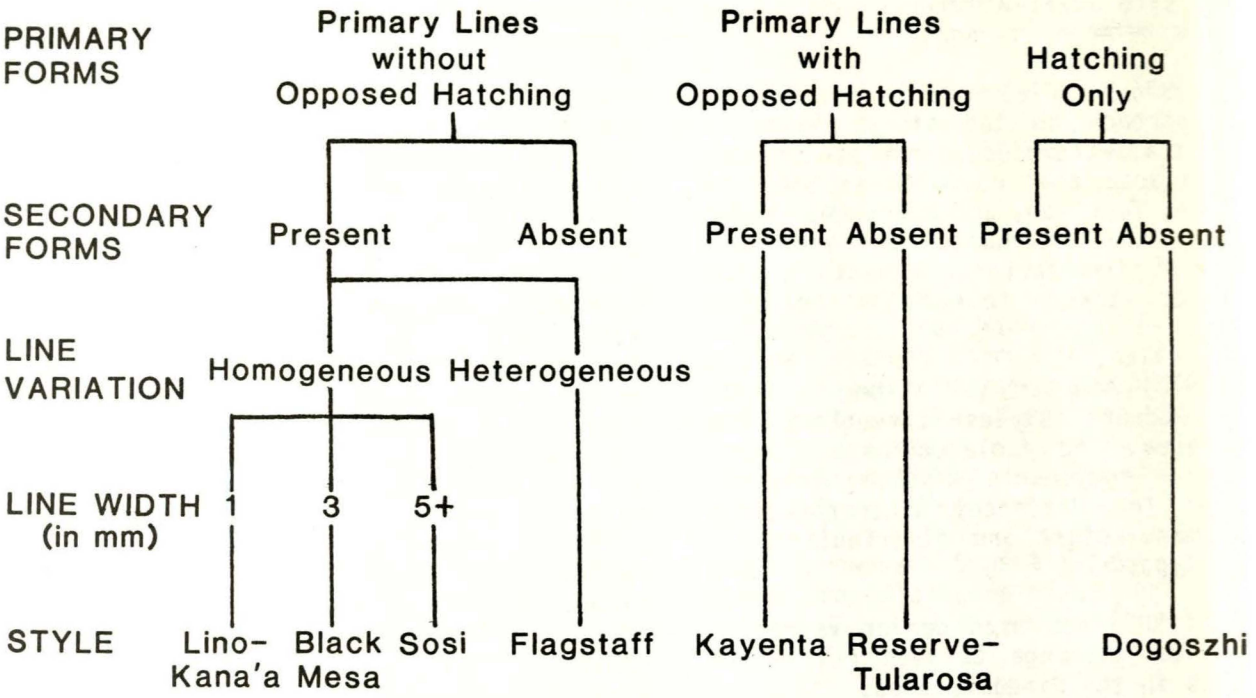



Figure 19. Dendrogram illustrating attribute based system of style definition.

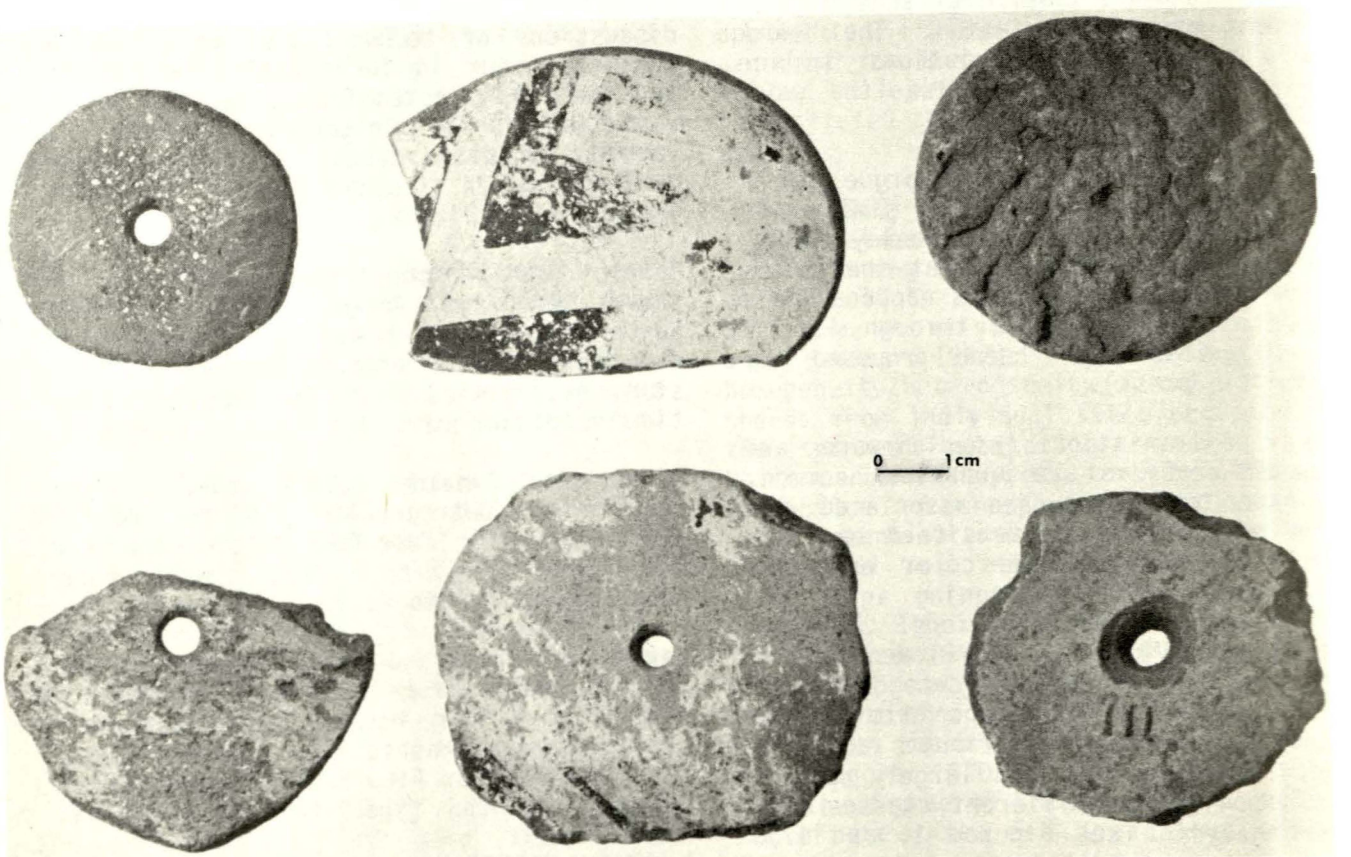



Figure 20. Ceramic artifacts which appear to have been reused in a role different than originally intended. The center sherd of the top row appears to be a scrapper. The other sherds have been drilled for decorations or spindle whorls.

locally. S. Plog (1977:75) described the conflicting results of this report and the original and subsequent analyses of materials from the site.

Gamboa (1972) undertook a simple visual mapping of the distribution of the alphabetic types within the Chevelon drainage. His analyses suggested quite different distributional patterns for the various types within this drainage.[1] The earliest classes, USM and USO, occur at quite dispersed loci, although there is a tendency for a relatively heavy USM and a relatively heavy USO site to occur in pairs. PSO predominates along the southwestern edge of the drainage although there are some loci in the very center and at the northern extreme of the drainage where it is also abundant. Polished Sand Mineral (PSM) has a spotty distribution that correlates closely with PSO. Slipped sherd organic, the largest single category, occurs in high concentrations at sites throughout the drainage. PGM is concentrated in the southeastern part of the drainage and shows a strong zonal pattern of decline from the centers of heaviest concentrations.

Aceves (1970) studied a sample of black-on-white sherds from the Chevelon drainage in an effort to differentitate chemically between mineral and carbon paints. She determined that the percentage of iron and manganese in the clays from which the vessels were made was so high, and the separation of pigment from the clay body so difficult, that all sherds appeared to be mineral. In addition, she discovered that the quantity of magnetic particles in all sherds examined was too small to use a magnetic test as a basis for the differentiation.

DeAtley (1973) undertook a petrographic study of 61 plainware sherds from 6 sites in the Purcell Larson locality of the Chevelon drainage. Her study summarizes archeological literatures concerning techniques of ceramic manufacture and the relationship of raw materials used in manufacture to the function for which the vessel is intended. She began with sherds of all but one of the classes used in sorting sherds from the area using the alphabetic typology: Red Brown Crushed Rock, Red Brown Sand, Red Brown Polished, Red Brown Sherd, and Red Brown Volcanic. Her analysis indicated that three groups were represented petrographically: sherd temper, silicious temper including sand and variable quantities of crushed rock, and volcanic. Sherd tempered vessels proved to be predominantly bowls, which she infers to have been used in cooking, while silicious tempered vessels where predominantly jars, inferred to have been used in storage.

DeAtley notes that while her study began with a set of temporally disparate data, the temporal patterning strongly suggests a preponderance of jars at the two earliest and the two latest sites and of bowls in the two intermediate ones. Thus, she argues, site function may have inadvertently affected the sample. However, subsequent analyses (S. Plog n.d.) have shown that sherd tempered vessels are the common ware from about AD 1000 to 1100 within the area. Therefore, her results can not be attributed to sample bias, leaving the interesting possibility that storage, at least in jars, did not occur at a constant level during the prehistory of the area.

There is another important implication of DeAtley's study. Given that Red Brown Crushed Rock is the equivalent of Tonto Brown (an Alameda Brown Ware), and that Red Brown Sand is the equivalent of Alama Plain (a Mogollon Brown Ware), then perhaps the plainware sherds of these types in the Chevelon drainage are a locally manufactured ware that represents an admixture of the two traditions. Alternatively, somewhere in the vicinity of the study area there was a ceramic manufacturing center where a technology blending the two traditions was utilized. Otherwise, the two should be easily separable. In my opinion, there are within the study area clearly distinguishable Alma Plain and clearly distinguishable Tonto Brown. In the absence of further petrographic studies, it is impossible to describe the precise extent to which the variation between the two is clinal with a discrete intermediate type.

Wait (1975) used spectrographic techniques to analyze a collection of 61 sherds, again from the Purcell Larson area. He was able to demonstrate, using statistical procedures, that Cibola White Ware sherds and Little Colorado White Ware sherds were clearly made with different raw materials.

1. Maps 15 through 21 contain definitions of the "alphabetic" types.

In addition, he argues that one can differentiate two groups of Cibola White Ware sherds, one with high values of zirconium and titanium and the other with high values of iron, strontium, zinc, and rubidium. Similarly, Little Colorado White Ware sherds sort statistically into two groups, one high in titanium, the other high in manganese. It was difficult to explore the spatial and temporal implications of these findings. However, since there is limited temporal variation between the sites, it appears likely that more than a single source of manufacture is indicated for each group.

Wait's analysis of the spatial patterning in the distribution is intriguing, if not conclusive. One of the Cibola groups isolates a cluster of sites in the center of the drainage. The other groups two sites at the northern and southern ends of the drainage. These two sites may be somewhat later than the others, but they are also both sites with four wall structures that potentially played an important role in exchange relationships as discussed elsewhere. The anlysis of the Little Colorado White Wares is somewhat more difficult to interpret. While one group consists of the five northernmost sites, the second includes sites from the entire drainage.

Wait proposed an argument concerning the use of different raw materials for bowls and jars that is similar to DeAtley's. However, subsequent investigations by S. Plog (1980a) suggest that, since jars and bowls produce drastically different quantities of sherds, Wait's argument is highly problematical.

Read (1974) used limited neighborhood classification analysis to study the distribution of classes defined using the Chevelon typology over sites in the area. He argued that the clusters of sites generated by the analysis represented temporally discrete groups. S. Plog (1980a) described tree-ring dates that support this argument for at least a portion of the time period in question.

Muessel (1975) used X-ray diffraction to study a sample of 44 Little Colorado White Ware sherds from the Purcell Larson area of the Chevelon drainage. He found that the population of sherds could be separated on the basis of the relative quantities of quartz, feldspar, and calcite. Group one shows no calcite and a predominance of quartz over feldspar; group two shows a predominance of quartz over feldspar over calcite; group three has a predominance of quartz over roughly equal quantities of feldspar and calcite; and group 4 a predominance of feldspar over quartz over calcite. There is considerable variation in the frequencey of sherds for the 11 sites that Muessel studies that are from a single class. In three sites, all sherds were from the same class. In two cases, three were from one group and one from another, and in the remainder of cases the sherds were equally divided between two groups.

Muessel was unable to find any clear spatial patterning in the distribution of these different groups. However, there was an apparent temporal pattern. Sherds from the earliest sites were from groups two and three. Group one was middle to late and group four was late.

Unfortunatley, the sherds used in Muessel's study were selected specifically because they had no paint on them, so as not to interfere with design analyses. As a result, our understanding of this pattern of technological change cannot be refined. However, there is a suggestion that the manufacturers of Little Colorado White Ware were attempting to use raw materials that were free of calcite. While they may also have been attempting to replace quartz-rich with feldspar-rich clays, this pattern may simply be the product of the kinds of sherds that were used to manufacture the sherd temper. Earlier, there would have been little choice but to use quartz-laden Tusayan White Ware sherds for the temper, while later Little Colorado sherds could themselves have been used, reducing the quartz fraction in the temper.

F. Plog (1976) discussed the justification for the development of the Chevlon typology and defines each of the classes used in this approach. S. Plog (1976) describes the results of 22 SShO and 20 PGM sherds from the Chevelon area done by Elizabeth Garrett. Igneous rock fragments were found in the SShO but not in the PGM samples. Analyses of additional samples from the study area and sites to the north and west of it suggested that sherds from south of Winslow were very similar to Chevelon sherds.

Fifty-five sherds of black-on-white ceramics representing Reserve, Snowflake, Puerco, and Wingate wares as well as unspecified plainware sherds were analyzed as part of the Tucson Gas and Electric Project near Springerville (Rugge and Doyel 1979). They assigned sherds to one of three classes on the basis of varying sherd, quartz, feldspar, quartzite, sandstone, granite, chert, and volcanic inclusions. Suggestions concerning the probable local origin of each of the classes are given. Plain and corrugated wares were both more variable and of different tempering materials then the painted types.

Dulaney (in press) discusses the results of his analysis of 75 sherds obtained during the various phases of the Coronado Project in the northern part of the study area. The results of Dulaney's study are complex and highly intriguing and the discussion is more thorough than in any of the previously mentioned reports. Some of the major conclusions reached are:

a. Alama Plain sometimes does, but sometimes does not, have sherd temper inclusions.

b. There is little petrographic relationship between Alma Plain and Woodruff Smudged even though both are said to be Mogollon types in the traditional literature.

c. Despite clear evidence that tempering particles were purposefully added to the sherds and were not accidental inclusions, variation over the project area is minimal for the two types in question. This suggests highly localized manufacture.

d. Evidence for localized manufacture is substantially greater for those painted types which generally date to AD 950-1150.

e. Even the earliest Cibola types in the project area had sherd temper present in some sherds (unpainted Lino-like plainware).

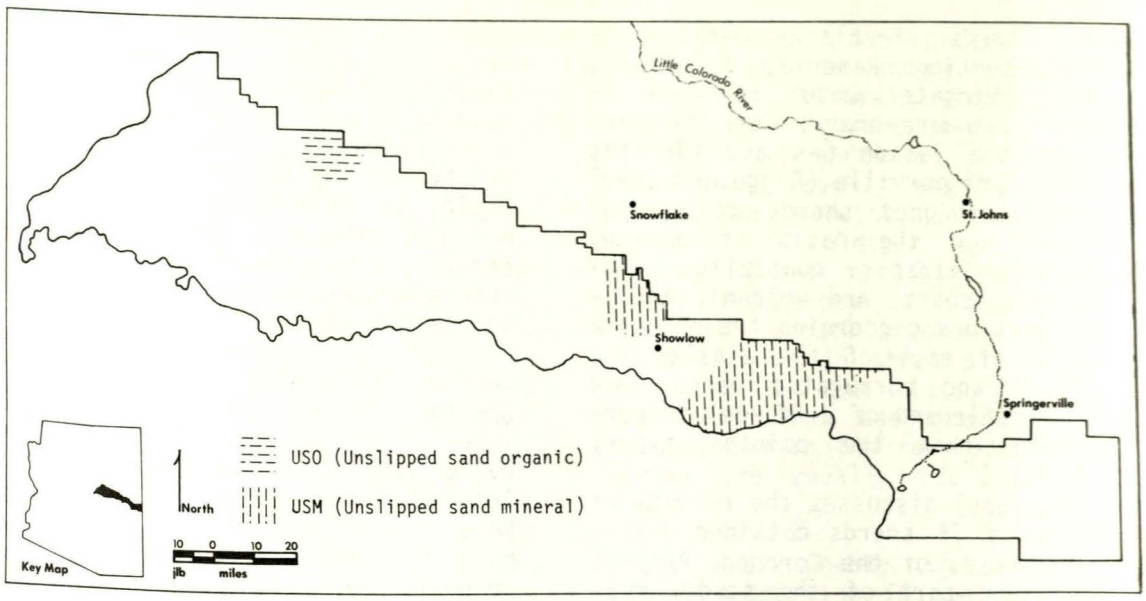
Dulaney's report also contains useful suggestions concerning the directions that future studies might take and the standards of analysis and reporting that should be sought. There is no question that, had these same standards been met in earlier reports, our ability to generalize about technological variation would be substantially greater.

As a part of ongoing research on the Apache-Sitgreaves National Forests, Elizabeth Garret has summarized the results of analyses of about 160 (some are still in progress) sherds from the breadth of the Apache-Sitgreaves National Forests. While the results of these analyses are not yet complete, they suggest discrete regions over the study area in which petrographic characteristics are substantially the same.

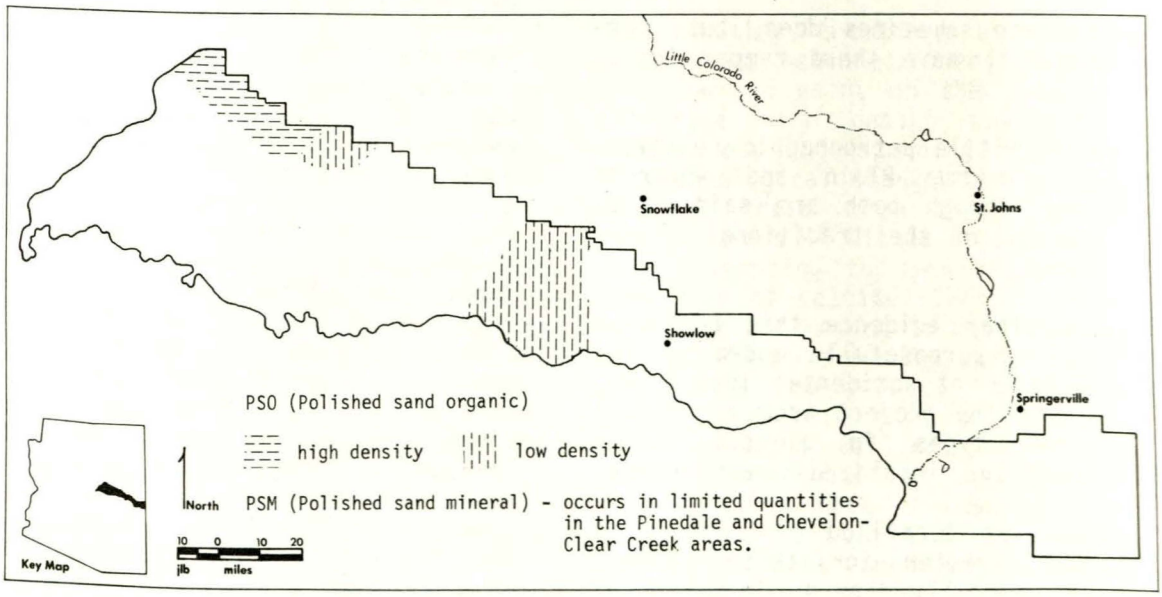
Jeffrey McAllister (1978) has mapped the spatial distribution of the different types in the painted classes of the alphabetic typology using the SYMAP program. The results of these studies are shown in Maps 15 through 21. In general, these maps correspond closely both with those generated by Brunson in her studies of corrugated variation mentioned above and the petrographic zones as visually defined on the basis of Garrett's petrographic analysis.

S. Plog (n.d.) undertook a cluster analysis of all the types in the Chevlon typology. His analysis indicates four covarying groups. Group one consists of USO, USM, Gray, and Red-Brown Sand, essentially the earliest Tusayan White and Gray Wares, Mogollon Brown Wares and Cibola White Wares. Group two consists of PSO, and Gray Sand and Sherd Corrugated, the Tusayan White Ware and Gray Corrugated types and Little Colorado Gray Ware. Group three consists of SShO, Red-Brown Sherd, Polished and Volcanic, a basic complex of sherd tempered pottery plus the Sunset types of Alameda Brown Ware. The final group consists of PGM and Red-Brown Corrugated, an association of Cibola White Wares with Mogollon and Tonto Corrugated types. The analysis strongly suggests that the various alphabetic classes occur in a pattern that is either spatially or temporally patterned, or both.

Plog also investigated the relationship between corrugated and plainware ratios and the more readily dateable black-on-white classes. He found that while there was an association, it was spatially varied. In the Chevelon Canyon area, corrugated sherds are relatively rare, even at later time periods. Sites with a majority of corrugated sherds typically have greater than expected quantities of SShO and less than expected quantities of USM and USO and PSO. However, PGM does not pattern in relation to the corrugated




Map 15. Distribution of USO and USM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.

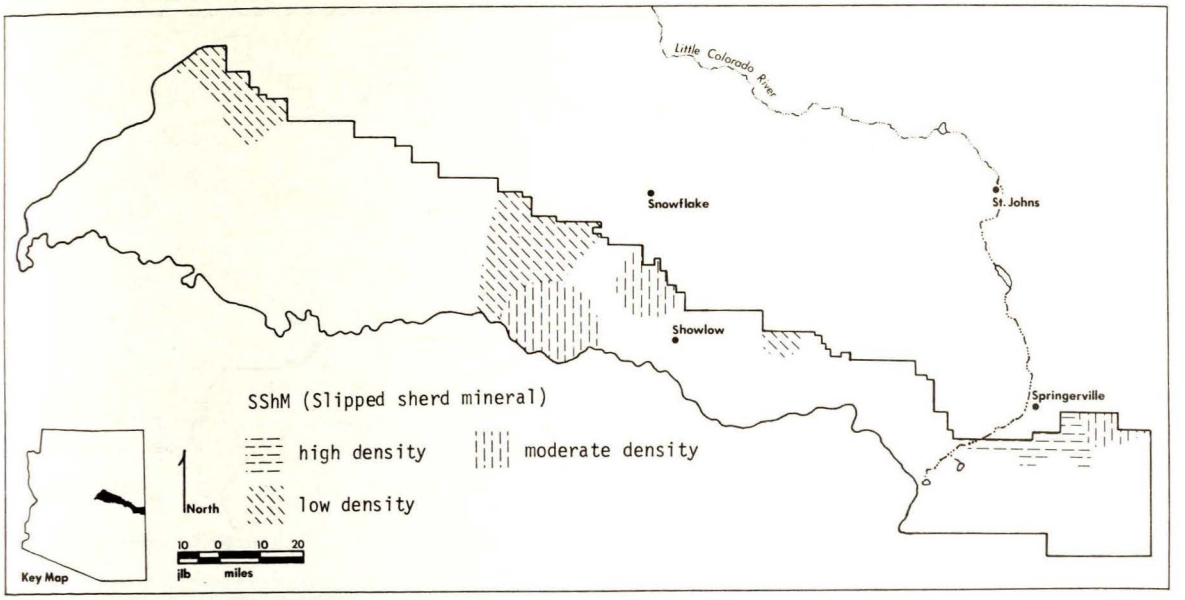



Map 16. Distribution of PSO and PSM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.

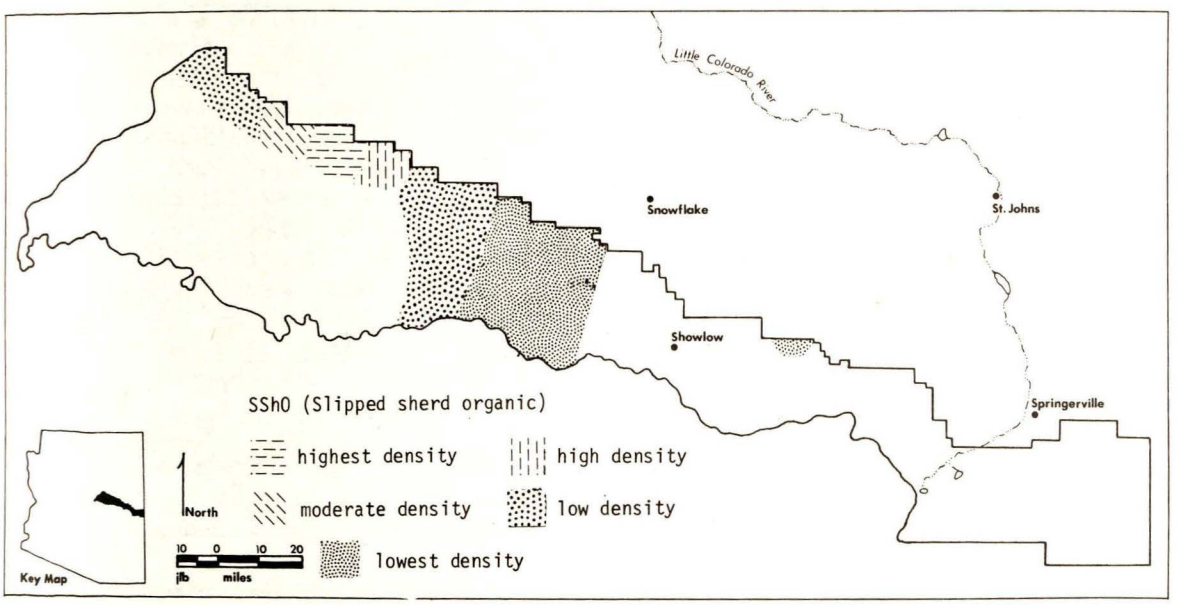
plainware proportion. In the Purcell-Larson area, sites with a majority of corrugated have greater than expected quantities of PGM and SShO, less than expected quantities USO and USM and expectable quantities of PSO. In this area, there seems to be a gradual plainware-to-corrugated transition that breaks during the period of time when PSO predominates.

## FUTURE RESEARCH

While none of the techniques employed are new in principle, research during the last two decades has greatly expanded the detail of understanding of both the technological and stylistic aspects of ceramic variation. The number of petrographic samples that have been analyzed is nearly ten times that



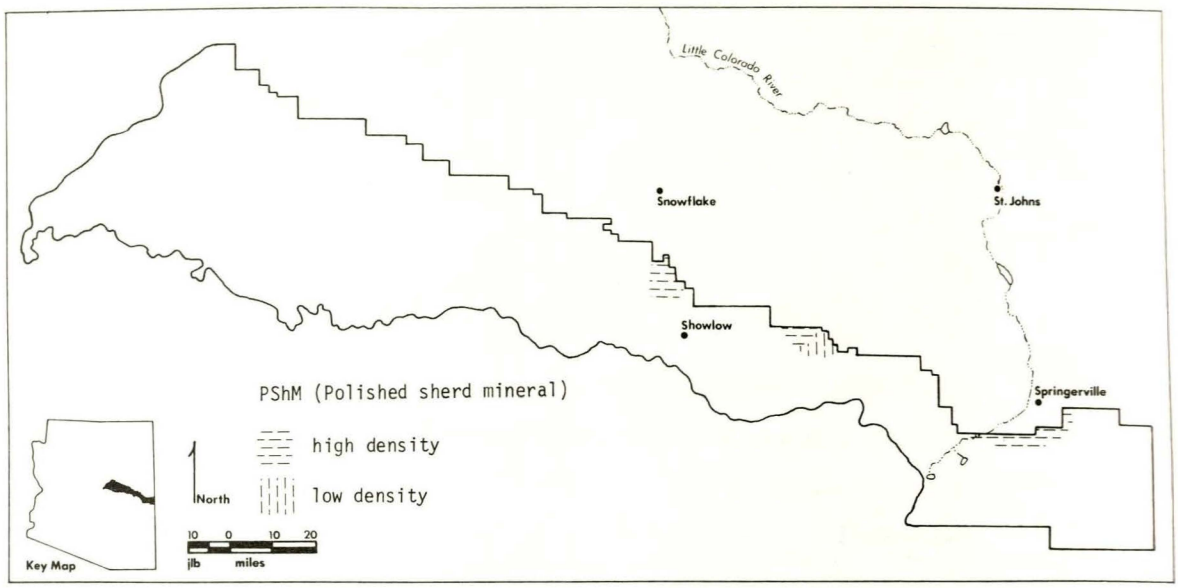

Map 17. Distribution of SShM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.



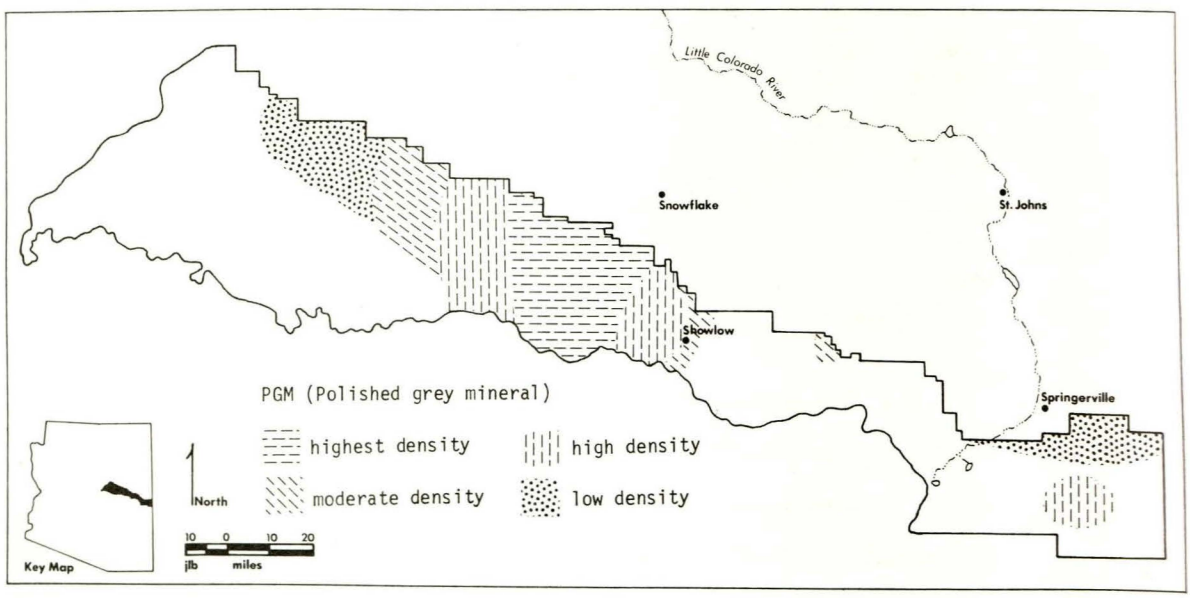

Map 18. Distribution of SShO ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.

done during the entire preceding period. Specific efforts to map the distribution of design elements and attributes both within and between sites has yielded successful, if not always conclusive, results. A much different issue generated by these efforts is the status of traditional typologies given our rapidly increasing understanding of the details of variation.

There seems to me no question that there is great utility in the continued use of the traditional typology. A well trained analyst can sort sherds into meaningful categories on the basis of minimal observations and, therefore, with considerable speed. The weakness of this approach is, of course, the great number of observational errors that arise when a



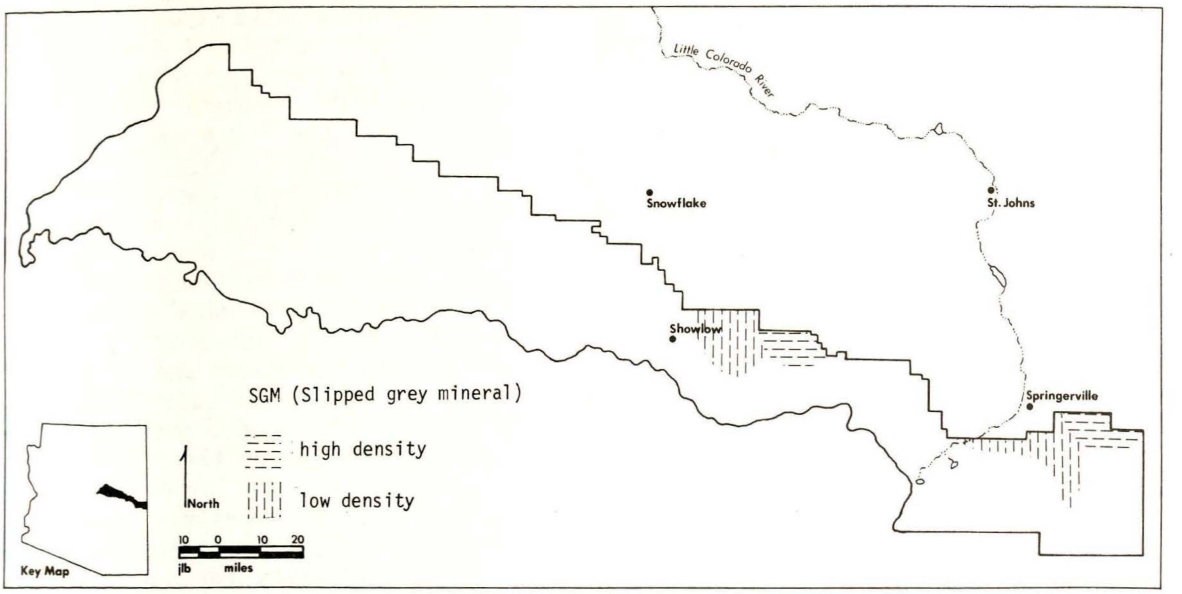

Map 19. Distribution of PShM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.




Map 20. Distribution of PGM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.

relatively few attributes are used to place sherds or vessels in a system that is based on dozens of attributes. It is not surprising that the high rate of disagreement among similarly trained analysts reported by Fish (1978) occurs nor that the more substantial disagreement over even whole vessels reported by Swarthout and Dulaney (in press) should happen. Current efforts to generate a set of definition of Cibola White Ware types should greatly clarify the pattern of black-on-white types within the study area.

Yet, in the case of every ware there remains great need for clarification. Despite the commendable overall level of comparability that Colton was able to




Map 21. Distribution of SGM ceramics of the Chevelon classification system from the Apache-Sitgreaves National Forests.

achieve, there are conflicts in his typology. For example, the definitions for Walnut C and Holbrook B in the Little Colorado White Ware are identical. Similarly, St. Joseph Black-on-white is defined on the basis of two sherds. Variability in plain and corrugated wares has never been adequately studied with a view toward consistency. The extent of overlap between Woodruff Smudged, Forestdale Smudged and San Francisco Red has never been adequately determined nor has that between most of the types in the Forestdale, Alma, Woodruff series.

I am not suggesting that there is a need to sit around tables covered with sherds and decide what is what. At issue is simply resolution of the question of the kinds and details of the attributes that are to be used in the system. Most of the current confusion exists either because inferred spatial and temporal contexts, rather than formal attributes, were used to define new types. Laboratory variation in the definition of attributes, or actual attributes used, add to the confusion. Given an agreed consistency in attribute systems and observational techniques, there should be no problem in using the traditional typology as a first-instance communication concerning the nature of ceramic materials that are common in a particular project. Such an approach might proceed as follows for each of the major wares.

1. General: Types should be defined at the intersection of relatively clear, but relatively simple, stylistic and technological categories.

2. Black-on-White: A number of current types appear to be defined almost exclusively on spatial and/or temporal grounds. The use of such terms should be abandoned. A technological system based upon the existing Chevelon system and a system such as that described earlier should be used to generate the types.

3. Black-on-Red, Orange: Little attention has been given to either stylistic or technological variation in these types within the study area. Carlson's (1970) work with White Mountain Redwares is the exception. Graves' (1978) analysis suggests that many of the same style categories that are useful for black-on-white types will serve for these. Technological variation is largely an open question at present.

4. Polychromes: The existing definitions of polychromes probably represent the most consistent set of defined types at present.

5. Plainware: In the case of plainware, style is essentially a matter of surface color and surface treatment. Yet, there is no consistent set of categories at present. These should be generated. Technological

variation has been inconsistently handled. Wilson (1969), for example, distinguishes between types of Alameda Brown Ware on the basis of the relative percentages of different mineral inclusions. This approach is unwieldy for the level of analysis envisioned in this discussion. On the other hand, there are apparently undifferentiated sherd and sand tempered varieties of the Alma series.

6. Corrugated: The same technological problems that characterize current descriptions of plainwares occur in the case of corrugated types. These need to be resolved. Stylistic descriptions have been based on the pattern of surface coils, bands, and indentations. Brunson's statistical analysis has demonstrated so much overlap that relatively few categories will suffice, such as obliteration, partial obliteration, indentation, banding, and patterning (including scoring, punching, etc.). Yet, her analysis is for only a portion of the study area and more detail may be required.

7. Painted Corrugated: Neither stylistic nor technological variation is well described. For example, our collection includes white-on-red, white-on-orange, black-on-red, black-on-orange, red-on-orange and virtually all of the possible polychrome-on-orange combinations. Whether this is a local manifestation that does not require resolution at the regional level, or if a regional resolution is required, is unclear at present.

Improvement of the typological system is only a means to enhance communication among different archeologists working on different research problems within the study area. The case for more detailed analysis is already made. Despite the generally negative attitude toward the pioneering studies of stylistic variation done by Longacre and Hill, the principle on which their work most fundamentally rests is now established; at virutally every level of spatial detail, patterning can and should be sought. Hantman and Lightfoot (1978) have made the same case for temporal patterning. It is dubious that the detail required for any of these analyses, nor for containing the variation that is demonstrated by petrographic studies, should become a part of a typological system as that system would rapidly become too complex and costly to use. However, the useful information that can be obtained from these more detailed studies is now well understood.

The problem with the approach taken by Hill and Longacre is the overly simple interpretation that was placed on the results. Spatial, temporal, and functional patterning were not clearly distinguished. As S. Plog has shown, and subsequent analyses have confirmed, one must clearly distinguish between the three. Nevertheless, Plog's and subsequent analyses have found attributes of ceramic variation that can be used for more detailed inferences when these overall dimensions are adequately treated.

# CHIPPED AND GROUND STONE

## INTRODUCTION

Chipped stone artifacts have received far less attention in efforts to interpret the prehistory of the unit than have ceramic ones. As late as 1964, one major site report (Martin et al., 1964) grouped chipped stone artifacts into the following categories: projectile points, drills, saws, gravers, knives, scrapers, choppers, and scraper planes. No discussion of the reasoning behind the typology, nor why they used an abbreviated version of a previously far more complex one, was presented. The results of the classification were not incorporated into the interpretation of the site in question. This approach is by no means unique; it is an accurate reflection of the manner in which chipped stone had been handled for decades.

Within the last 15 years, this situation has changed drastically. Chipped stone has become a major focus of analysis as archeologists sought to identify "tool kits" or to describe the variation in the techniques used to manufacture particular artifacts or particular chipped stone assemblages. A bewildering array of attributes are now used in the study of most assemblages. In one recent effort these included: raw material; flake condition; length; width; thickness; length, width, and thickness of the platform; residual striking platform; platform preparation; number of dorsal scars and type of scar; of cortex; flake termination; eraillure; lipping; force lines; bulb of percussion; symmetry; utilization; and edge angle. An even longer list of only partially overlapping variables could be described for recent analyses of projectile points alone.

At the same time, chipped stone has been seen more and more as a source of important information concerning behavior and culture. Exchange and site function are two of the most common patterns that are investigated using this material. At present, there has been no effort to integrate the results of these diverse studies into a single overarching typology. The necessity of such an effort is debatable although it may prove useful. At present, it is possible only to describe the diverse courses that investigations have taken.

## TYPOLOGY

A first major area of investigation is typology. While an adequate typology for the study area clearly does not exist, a number of studies on which such a typology might be based have been done in recent years.

The first departure from the use of intuitive typologies in analyzing chipped stone is Longacre's study of materials from Broken K Pueblo (1967). He used metric measurements of flake lengths and widths to argue for selectivity in the use of flakes of different sizes for the manufacture of different tool types. He also analyzed, using a rudimentary typology, the different categories of chipping degree and found differences between some room blocks at the site. Perhaps most importantly, he found that habitation rooms and storage rooms with features had many times more chipping debris than storage rooms without floor features.

Decker (1976) studied roughly 1400 chipped stone tools from the Chevelon drainage in an effort to identify classes within the general category of scrapers and knives. Of a large set of attributes studied, he concluded that edge angle, edge length, and edge contour were the significant variables for defining the classes. He identified two problems in the use of any such system, however. First, the approach cannot be applied to whole artifacts but to each worked edge and potentially to independent use episodes on each edge. Second, even using the variables he mentioned, computer analysis is necessary to group the artifacts in question. On balance, these results suggest a very casual pattern of artifact use in potentially quite different activities.

Perhaps the best attempt to rethink the issue of chipped stone typology is that of DeGarmo (1975). His analysis of the assemblage from Coyote Creek Pueblo included a clear description of each of the categories into which artifacts were sorted. While the effort included only minimal results of statistical analyses of artifact types, it did provide historical background concerning other references to the type,

hypotheses concerning the function that each type served, and a discussion of some experimental results that DeGarmo used in attempting to establish function. The distribution of different artifact types in rooms and room blocks at the site was also described. These data, in combination with others, suggest both variation in the use of different parts of the site and specialization in the production of at least some items.

## MANUFACTURING PROCESSES

A number of studies have attempted to define patterns of change in the manufacture of projectile points and other bifaces within the overview unit. Traugott (1968, see also Plog 1974) studied the relationship between heat treating and flake form in the case of projectile points from sites in Hay Hollow Valley. His study contributed to understanding the manner in which projectile points are manufactured. Specifically, projectile points made using primary flaking to thin the flake tend to be heat treated. Projectile points made simply by trimming the edge of the flake (secondary retouch) are generally not heat treated. Generally the secondary retouch is used to produce triangular forms on flakes removed from cores so that they are already sufficiently thin. The flakes produced by the second process are far more standardized than those produced by the first. The first process is the earlier and is superseded by the second at about AD 800. Early and later points are shown in Figures 21 and 22.

The complicating factor is the apparent widespread reuse at later sites of flakes made by the older process. While flakes made using the second process are rarely found on early sites, flakes made by the second are widespread on later ones. This pattern occurs on sites from the entire Apache-Sitgreaves National Forests area. Figure 23 illustrates a particularly compelling case. At the same time assemblages from some sites are highly standardized (see Figure 24).

## CHRONOLOGY

Further analyses have attempted to identify specific changes in projectile point form sufficient for establishing an areal chronology (Li 1973, Sexton 1976, Rafferty 1977, Coulam and Hutira 1979). Li attempted to generate a usable system using a modification of Whallon's (1972) technique for generating a hierarchical classification system. While a usable typology was developed, it proved to have minimal chronological value. Rafferty's effort was based upon Li's and yielded the same conclusion. Five attributes were used in these two studies: basal width/blade width, primary flake type, basal curvature, length, and width. Sexton employed a greatly expanded set of attributes: distal shoulder angle, proximal shoulder angle, basal indentation ratio, length-width ratio, notch opening, maximum width position both distal and proximal, basal width/maximum width, length/width, longitudinal cross section and transverse cross section.

Rafferty's analysis resulted in the identification of four basic projectile point types: unstemmed with basal indentation, unstemmed without basal indentation, stemmed side-notched, and stemmed corner notched. Before about AD 1100, unstemmed points with no basal notch and stemmed, side notched points predominate. After about AD 1100 basal indentation on stemless points and corner notching on points with stems are characteristic. While he interprets the data in spatial terms, an evaluation of Sexton's results also suggest that prior to AD 1100, points are thicker. This is consistent with Traugott's argument concerning a shift in the manufacturing process. In my experience, the later points are also far more standardized in size and shape.

Coulam and Hutira (1979) used a combination of cluster and discriminant function analysis in an effort to identify temporally sensitive projectile point forms. Their analysis suggested some possible relationships between body and basal width. However, there was no apparent spatial or temporal patterning to the distribution.

## FUNCTION

The function of specific tool types has been explored and used in efforts to contrast different activity areas on sites, on different types of sites or in different parts of a particular study area.

Garson (1972) studied the color characteristics of chipped stone artifacts and the

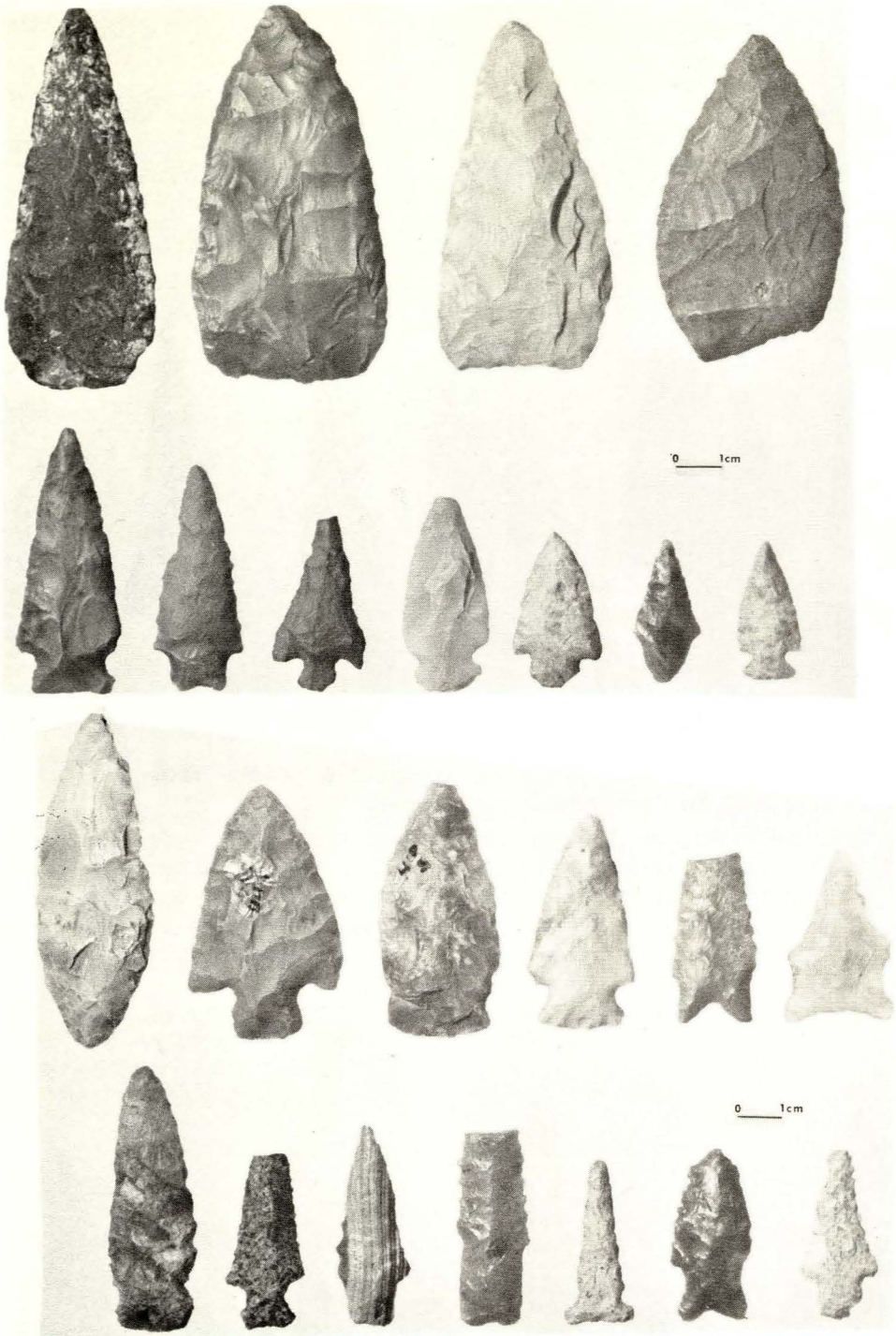



Figure 21. Early projectile points and bifaces from the overview area.

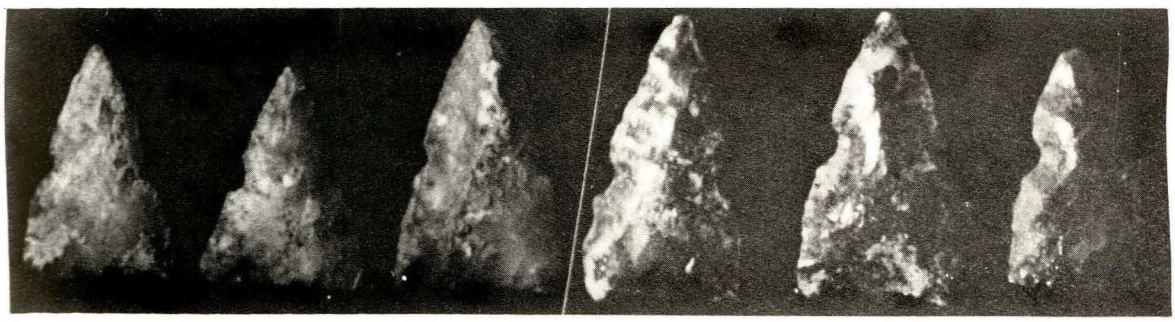


Figure 22. Highly standardized points from Navaqueotaka, a large late pueblo just outside the Little Colorado overview unit. The average point is 1.5 cm long.

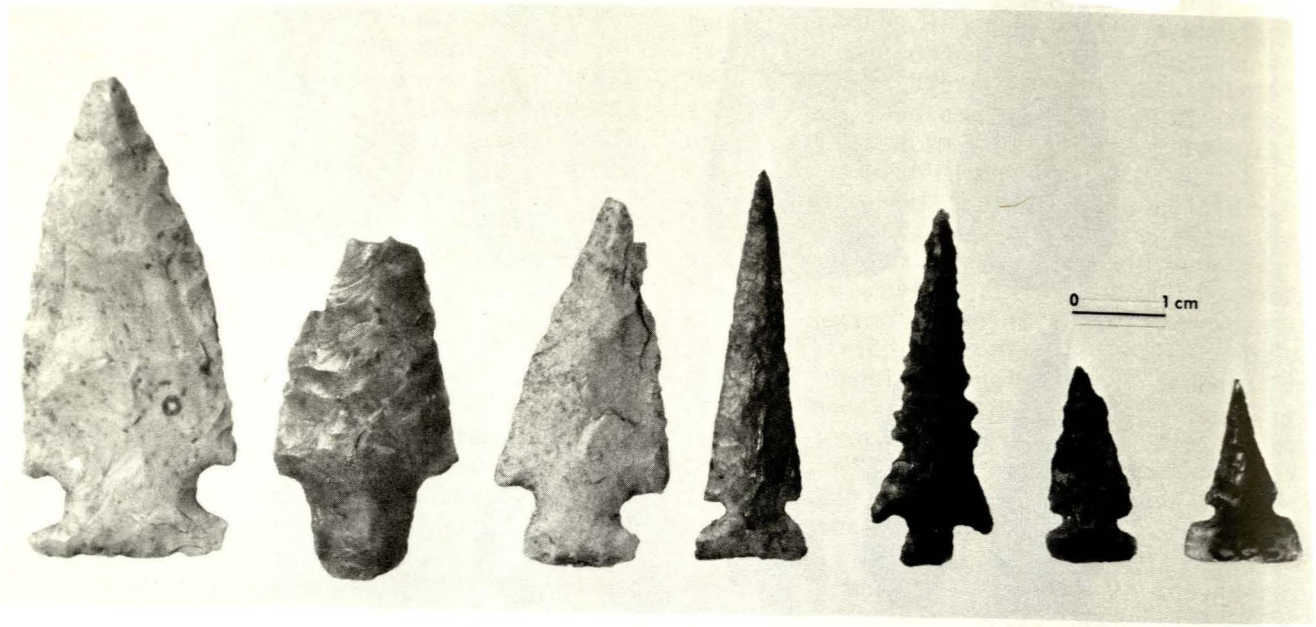



Figure 23. The range of variation in projectile points from a single pithouse (CS-553) in the Chevelon drainage.

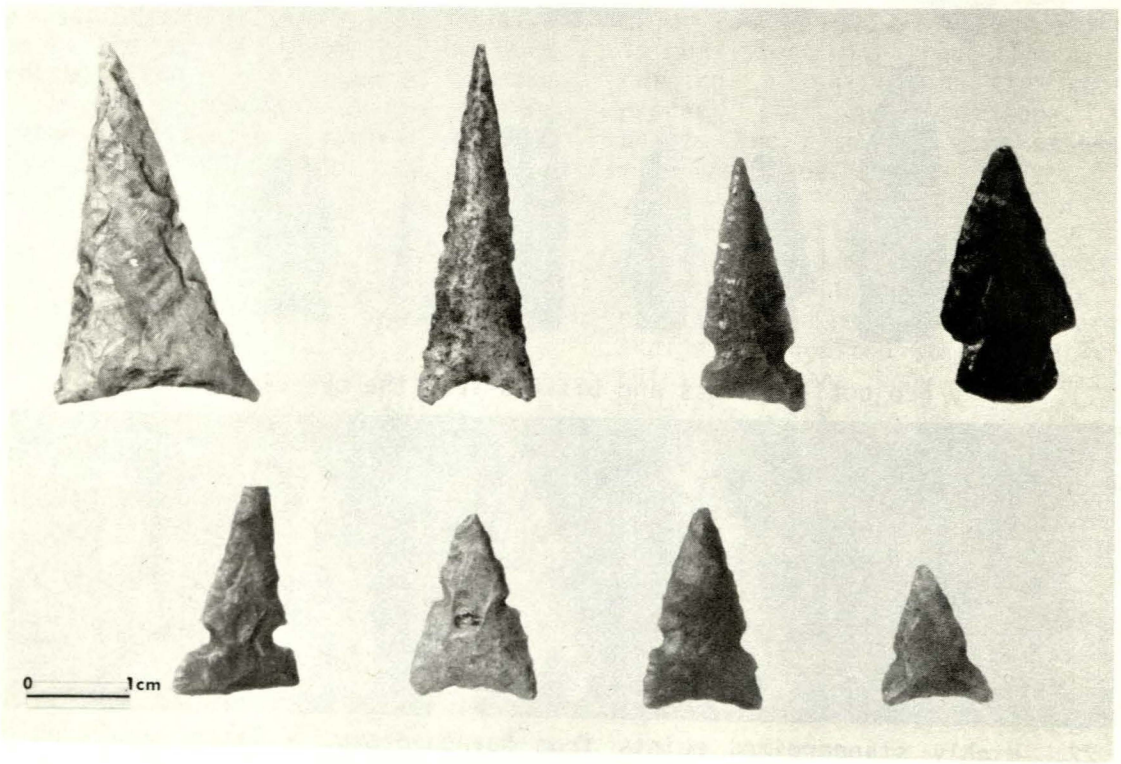



Figure 24. Later projectile points from the overview unit.

materials from which they were made at site NS28 in Hay Hollow Valley. A sample of cherts and chalcedonies were collected from source areas in the immediate vicinity of the site. Garson postulated that there might have been selection of different colors of raw materials by different social units or for manufacturing different types of artifacts. His results suggested that no such selectivity occurred. Only in the case of chalcedony was there any apparent selectivity and the possibility could not be rejected that this pattern reflected a selection of a higher quality raw material.

Schiffer's (1976) analysis of chipped stone artifacts from the Joint Site is probably the most comprehensive analysis of variation in chipped stone artifacts undertaken in the study area. His effort includes a lengthy discussion of the strengths and weaknesses of various approaches to the study of both tool manufacture and tool use. Among the major substantive conclusions of his research are the following:

1. Chalcedony, the rarest of the raw materials used at the site, was also the most intensively used and reused. The number of worked edges on flakes and the amount of shatter are significantly higher than for either quartzite or chert.

2. Quartzite was most frequently used in the manufacture of large tools and chalcedony in the manufacture of smaller and especially bifacially retouched tools.

3. When the chipped stone artifacts from secondary refuse are analyzed using factor analysis, three factors can be isolated. The first consists of utilized flakes and utilized shatter with all but very steep edges. With the exception of quartzite artifacts, all had been used. These tools were most probably used in a wide range of cutting activities and for processing a wide range of raw materials throughout the site. Factor two is defined by some unutilized chert and all unutilized chalcedony waste flakes, although a hammerstone and several formally made tools are included. This factor is probably associated with the manufacture of chipped stone tools, primarily in the rooms and on the roof of the pueblo. Factor three is defined by chert and quartzite waste flakes. Again, chipped stone tool manufacture is indicated but in the areas away from the room block where the raw materials occur. I suspect that this factor may represent the initial processing of the raw materials.

Stone (1975) analyzed a large collection of chipped stone artifacts recovered during survey of the Chevelon drainage. Her approach was based upon "fuzzy set theory" a technique that is useful when the association of a particular observation with a particular activity is only probable rather than certain. The investigator specifies the probability in question and this inference becomes a part of the analytical procedure.

Stone's analysis required identifying the probable activities with which unutilized flakes, formal tools, and casual stone tools were associated. For each artifact category, the existing literature on stone tool use, consultation with colleagues, and inspection of the materials were used as Stone formulated the probabilities to be associated with each tool type. Actual observations are then transformed by the probabilities and become the data for analysis. The strength of this procedure is that the inference becomes a part of the analysis rather than a guess that is made after particular patterns of artifact association have been identified. Moreover, the result of the analysis is stated as a probability that a particular activity occurred at a particular spatial locus.

Using excavated materials, Stone found evidence of a high probability of stone tool manufacture and food preparation at all sites. The probabilities of hide preparation, butchering, hunting, and wood working were both generally lower and highly varied from site to site. A cluster analysis performed on the data formed two groups, one with a high certainty of all activities and the other with a high certainty of only a subset of all activities. Specialization in both room function and site function are suggested by the data.

Using the survey data, groups were again formed indicating different combinations of activities at different sites. A discriminant function analysis of the cluster results indicated an error of only 2.74% in assigning cases to the clusters. Butchering and food preparation were relatively useless in cluster formation; variation in these activities is so great from site to site that their presence at some

sites and absence at others is likely to be unrelated to the other variables. Most of the variation is associated with differential evidence of chipped stone tool manufacture on sites where hunting also occured. Hide preparation, and the processing of hard materials are the next most important activities separating the clusters. As was the case with excavation data, the largest group is formed of sites where the probability is high of all activities being present. The remainder of the groups are defined on the basis of associations between chipped stone tool manufacture and various of the other activities.

The study provides little evidence of any linear variation in the degree of site specialization through time. Instead, the degree of specialization seems to vary as populations disperse and contract through the drainage or move into areas that were previously nearly uninhabited. Also, the more generalized site types are characteristic of periods of relatively more abundant rainfall. Among later and larger sites there is good evidence for the performance of specialized activities in specific rooms.

Gibson (1975) investigated the relationship between edge orientation, edge angle and raw material type using a sample of 3000 artifacts from the Chevelon drainage. Her study indicated that the use of a lateral edge was the most common pattern for all material types and that there was little difference between the end and lateral edge angles. She found a trimodal distribution of edge angles roughly paralleling those described by Wilmsen (1970). While all raw materials showed working edges corresponding to these peaks there was a marked tendency to use vitreous cherts for tasks that involved lower edge angles, inferably slicing and cutting tasks. Quartzite showed some tendency to be used in tasks requiring the steepest edge angles. Basalt and chalky cherts were most abundant in the intermediate category of edge angles although no argument can be made that they were selected for tasks requiring edge angles of this category.

Dobbins (1977) studied a sample of 1800 chipped stone tools from 28 sites in the Chevelon and Pinedale areas, dating to 1250 to 1325 AD. He attempted to assess the extent to which limited activity and habitation sites in the juniper pinyon and ponderosa communities had different lithic assemblages. He examined the size of limited activity sites and the percentages of tools, types of decortication flakes, and cores found on limited activity sites found within the two zones. He was able to show that they were homogenous. Habitation sites in the two zones are, however, different. Sites of the pinyon-juniper community have more tertiary decortication flakes and fewer primary ones, and relatively fewer cores. Dobbins argued that the relatively greater numbers of cores and primary flakes found on sites in the ponderosa zone suggest only occasional manufacture of stone tools at these loci. Artifacts reflecting later stages of the manufacturing process occur in greater abundance in the juniper pinyon area because these sites were occupied on a more permanent basis, he concluded.

Saunders (1976) studied 275 chipped stone artifacts from four contemporaneous sites in the Chevelon drainage. One habitation site and one limited activity site in the grassland and pinyon-juniper woodland zones were selected for the study. He found evidence that, while all stages of chipped stone manufacture are indicated at habitation sites, only the thinning of already decortified flakes and cores occurred at the limited activity sites. The characteristics of the flakes used at the sites proved to be generally similar. There was no evidence of patterning in the use of different raw materials at the sites.

Briuer (1976) used techniques borrowed from the police laboratory in an effort to understand the materials on which chipped stone artifacts were used. He examined organic residues on the edges of chipped stone tools, 37 from O'Haco Rock Shelter, a Desert Culture site, and several from Coyote Creek Pueblo, an open air site. Residues were present on the Coyote Creek artifacts despite their having been washed. Chemical tests indicated that the vast majority of the artifacts were used for plant processing, although blood was indicated on the edge of one of them. Briuer was also able to show that the organic residue on the stone tools was unlike that found on natural objects in the rock shelter.

M. Donaldson (1977) studied a collection of nearly 800 chipped stone tools from 5 limited activity and 5 habitation sites in

the Chevelon drainage. The main difference she found between them related to the quantity and types of chipping debris. There is much more chipping debris at habitation sites than at limited activity sites although there is more evidence of immediate reduction of flakes from cores at the latter. There is also much greater evidence of selectivity of flakes for utilization at habitation sites. Differences in the length, width, and thickness of utilized, as opposed to non-utilized, flakes is significant at habitation sites but not significant at limited activity sites.

Grove (1977) studied a large number of characteristics of the raw material, tool type, and flake morphology of sites from the Little Colorado Planning Unit, west of Lakeside on the Apache-Sitgreaves National Forests. She attempted to distinguish between the lithic assemblages of artifact scatters, one or two room sites, and larger sites in this area. Few of the characteristics proved to be significant and those that did were questionable. These results stand in marked contrast to those obtained for the western portion of the Apache-Sitgreaves National Forests. The result is probably best understood in regard to the argument developed by Wood and others (Plog 1978). Basically, the evidence suggests that occupation of the eastern area was late and lasted for a relatively brief time. Given that the area is one of greater geomorphological activity than the more westerly areas, the structures on the "limited activity sites" may simply be buried. Alternatively, what may be represented is a series of large to small sites, with and without structures, all of which reflect colonization or temporary use of the area. This issue cannot be resolved at present.

Little effort has been spent in attempting to define types of ground stone artifacts in the study area. Generally, investigators have used an intuitive typology consisting of the following elements: one-hand manos, two-hand manos, basin metates, trough memtates, slab metates, palettes, mortars, and pestles. In some instances, manos have been further divided on the basis of bevelling. Mundie (1973) used statistical procedures in creating a more sophisticated typology for manos. Her results suggest that a relative few categories are necessary in order to classify

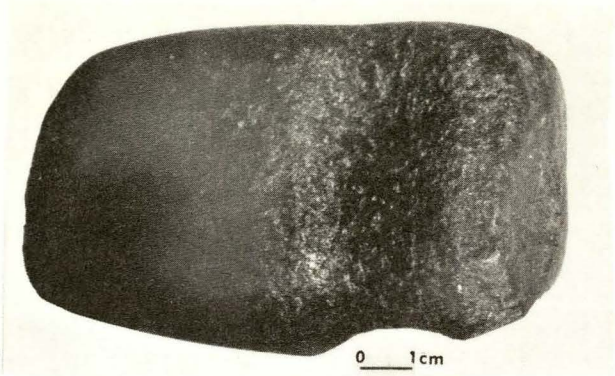



Figure 25. A ground stone axe from the overview area. This example is 10 cm long.

artifacts of this category. (See Figure 25 for an example of local groundstone.)

Slawson (1978b) examined a number of variables in an effort to separate aceramic from preceramic sites. Her basic strategy involved comparison of the lithic assemblages from ceramic sites with those from aceramic ones. Thus, the aceramic group must be assumed to include preceramic sites as well as sites contemporaneous with the ceramic ones on which ceramic artifacts were simply not used. As a result, the conclusions identified below could probably be strengthened by using them as a basis for separating preceramic and later sites and basing an analysis exclusively on those sites that have the apparently earlier characteristics. Major conclusions of the study were as follows:

1. Non-flakes (cores, shatter, and tools) are almost three times as abundant on aceramic sites as on ceramic ones.

2. Non-ceramic sites have a much higher frequency of secondary flakes.

3. Ceramic sites have a much greater abundance of tertiary flakes.

4. Quartz, orthoquartzite, and petrified wood only occur in non-ceramic sites and flints and limestone are far more abundant on them.

5. Andesite, jasper, calcite, and obsidian only occur on ceramic sites.

6. High percentages of edge angles greater that 76 degrees and less than 18 degrees are found on aceramic sites.

7. An abundance of edge angles in the 36 to 45 degree range occurs on ceramic sites.

8. More formally made cores and tools are found on aceramic sites and more different kinds of tools. There are some tool types that may be unique to these sites.

9. Utilized and unutilized flakes occur in greater abundance on ceramic sites.

Unfortuntely, the analysis also suggested considerable spatial variation in the results over the area that Slawson studied. Nevertheless, this suggestive evidence provides a substantial basis for beginning an effort to clearly distinguish between aceramic and preceramic lithic sites.

Most (1978b, 1979) has attempted to distinguish between various site types in the Pinedale area using lithic artifacts. The variables she considered include raw material, characteristics of the striking platform, cortex, and characteristics of the bulb of percussion. Using these variables pithouse, limited activity, and pueblo sites are generally similar. There are, however, two important areas of difference. First, raw materials are differentially distributed. Specifically, basalt tends to occur on the largest sites and to be more typical of later sites. This nonlocal raw material was imported into the area and possibly was processed at large habitation sites prior to distribution to inhabitants of smaller ones. Second, a number of variables that are associated with the production of tool blanks suggests that these artifacts may have been manufactured on limited activity sites.

In the Pinedale area, clear distinctions between habitation and nonhabitation sites are not possible. There are clearly some sites that would have been recorded as limited activity sites were it not for potholes that revealed walls. In combination with Most's data, most of the genuine limited activity sites in the Pinedale area may be loci at which raw materials were quarried from the Rim Gravels and initially processed. Given the highly ecotonal situation of the area, it is unlikely that separate resource extraction loci would have been necessary for most floral and faunal resources.

## EXCHANGE

A final major line of analysis focused on the exchange of chipped stone artifacts or the raw materials from which they were made. Until recently, most efforts to study exchange have used exotic resources such as obsidian. In recent years, a number of studies done using data from the overview unit suggest that there is great potential in studies of the distribution of more mundane resources.

Rick and Gritzmacher (1970) analyzed roughly 800 pieces of chipped stone from 10 sites in Hay Hollow Valley. The materials they used were surface collected from the sites. Their investigation did, however, test the relationship between surface and subsurface deposits at one excavated site and they concluded that surface materials were a good reflection of subsurface deposits. They divided chipped stone raw materials into five categories: chert, agate, petrified wood, basalt, and quartzite. Sources for each of the raw materials were located with only basalt and agate having restricted sources. This argues for a linear decrease in abundance of material as distance from the source increases.

The sites studied were occupied between AD 300 and 1300. While the percentage of chert, the most frequently used raw material, remained relatively constant over time, utilization of agate decreased and utilization of quartzite increased. Since agate is a higher quality material, I suspect that the replacement of it by quartzite may indicate exhaustion of the source material. While unwillingness to undertake the quarrying trip is a possibility, the source is only a few miles away from the most distant site used in the study.

One aspect of the study on which the authors did not comment is the extreme variation in lithic density on the sites which they studied. The range is from 1.1 to 21.5 per square meter. The coefficient of variation is .59 and the chances are less than 1 in 1000 that such a set of observations would be drawn from a population with the same mean. This suggests that efforts to distinguish site types might well focus on variation in the

overall quantity of chipped stone materials on sites and that there may be substantial variation in the quantity of material used at different points in time.

Green (1975) studied the distribution of chipped stone raw materials on sites of all time periods from the Chevelon drainage. She grouped raw materials into four categories: vitreous chert, chalky chert, volcanic, and quartzite. Throughout the sequence, vitreous chert was the most commonly used raw material, although chalky chert was most important in the southwestern corner.

Green found that different localities within the drainage, when evaluated using both SYMAP and cluster analysis, were relatively different from one another at all time periods. The raw materials used, with the exception of volcanic, were typically the most abundant locally available raw materials. Volcanic materials appear to have been traded into the drainage by peoples living to the west with the material entering the drainage at the confluences of Brookbank and Potato Wash with Chevelon Canyon. The distribution of the raw material follows the easternmost drainages within the Brookbank system. The period between AD 1175 and 1250 is marked by exceptionally high diversity in the use of raw materials. Nevertheless, the basic patterning is apparently spatial with much less indication of change in use patterns through time.

LePere (1979a, 1979b) has undertaken a thorough statistical study of the different raw material types used in the manufacture of chipped stone tools on the Apache-Sitgreaves National Forests. Her analysis indicates that chert and chalcedony were the most widely used resources with basalt and quartzite next in importance. Many less widely used resources (e.g., andesite, jasper, and siltstone) are used within relatively smaller spatial isolates. Obsidian occurs at low levels over the entire forest area.

A cluster analysis of the data, one that groups sites on the basis of different raw materials found on them, suggested several interesting conclusions. A three cluster solution basically segregated the western, central and eastern sectors of the forests. In an eight cluster solution, this division was still clear although the eastern sector was best defined on the basis of the high degree of variation in comparison with the other two clusters. In a 16 cluster solution, the eastern sector and the eastern third of the central sector show high variation in comparison with the remaining portion of the central sector and the western sector, both of which remain relatively consistent.

LePere also investigated the potential sources of the raw materials and in many cases was able to identify possible sources by simply using geological maps of the area and fall-off rates. Both linear and exponential rates were identified. Of course, the results of this analysis can be improved with field investigations to more specifically identify the sources. Some possible associations with site size and site type were also identified.

Findlow (n.d.) has studied obsidian from several hundred sites on the Apache-Sitgreaves National Forests. The technique that he has used to identify obsidian sources has been described previously (Findlow 1976). The major result of this effort is the discovery that, as far east as Pinetop, obsidian is predominantly from sources in the Flagstaff area. In the vicinity of Springerville and Eagar, Red Hill obsidian, from a source of that name in New Mexico, occurs in the greatest abundance, although Flagstaff obsidian still occurs in some quantity. The westernmost extent of exchange of Red Hill obsidian is the Pinedale area.

## FUTURE RESEARCH

The studies described above reflect substantial progress in obtaining an initial understanding of the nature of variation in chipped stone assemblages. While there has been considerable growth of understanding of the information that can be derived from particular variables, there is also still considerable guessing concerning the variables that are most likely to yield information and the manner in which these should be defined. A number of important questions now exist.

1. What is the source of materials used in manufacturing chipped stone tools? While a number of studies are reported that describe variation in chipped stone raw materials with tool-type, site type,

or time, the studies are exclusively based on data from sites. To date, with the sole exception of obsidian, no effort has been made to identify the actual sources of particular raw material types through field work. Provenience postulates must be established if we are to understand the nature and extent of exchange that brought the raw materials to the loci where they were used.

2. What productive/extractive processes are reflected in formally made stone tools? Virtually all of the studies reported herein clearly indicate that the assemblages in the overview area are relatively casual assemblages: used and minimally modified flakes are the most typical tool. Behaviorally, a very eclectic pattern in the use of chipped stone tools is suggested. The relatively infrequent occurrence of formally manufactured stone tools leaves open the questions of why, and under what circumstances, prehistoric peoples chose to invest additional energy in manufacturing more specific tool types.

3. Can preceramic and non-ceramic sites be distinguished? The study reported above is preliminary in nature and in no way resolves the question of whether this distinction can be clarified.

4. What is the nature of spatial and temporal variation in lithic assemblages found on sites of different types? Some of the studies discussed above indicate one or more variables that can be used to differentiate the assemblages of habitation sites as opposed to limited activity sites. In other cases, however, no such differences were noted. Whether this information reflects differences in the organization of productive activities from one portion of the overview unit to another, or at different points in time, cannot be stated with any security at present. It does seem clear that, in at least some areas, limited activity sites are characterized by relatively less chipped stone manufacture; this suggests that they were occupied for relatively short periods of time.

5. Is there a typology that is useful for comparing chipped stone from different projects? The development of such a typology would be a major undertaking were one to assume that it should proceed from statistical analyses of different artifacts to the establishment of formal types. Something less than this may be useful, however, for communication at the same level of detail envisioned in the discussion of ceramic variation. Were a system based on the use of a relatively few attributes in existence, [such a typology would be perhaps not too different from that used by DeGarmo (1975)] variation in functional and manufacturing patterns of a magnitude that would imply major cultural or organizational differences might be evident.

# SETTLEMENT PATTERNS: INTRA-SITE

During the last decade much of the intellectual investment in studies within the overview unit has been in studies of locational and settlement patterning. There is probably more detailed information on settlement related issues for various localities within the study area than any other area of comparable size.

In the case of both intra-site and inter-site patterning there are two general areas of analytical concern: the definition of the elements of settlement patterns and the analysis of the manner in which these elements are articulated and change in their articulation through space and through time.

## ELEMENTS OF INTRA-SITE PATTERNS

While efforts to identify room types have a long history in studies of southwestern archeology, it is only within the last 15 years that systematic efforts to identify attributes of different room types have been common. Prior to this time obvious distinctions (between kivas and secular rooms, between pithouses and surface storage units) were commonly made. Recent efforts have focused on the identification of more subtle differences between rooms that served different functions.

Efforts to systematically define and verify the existence of different room types begin with the work of Hill (Hill 1966, 1968, 1970; Martin, Hill, and Longacre 1967). The goal of this effort was to identify differences in room sizes and features associated with habitation as opposed to storage rooms. Kivas and "clan rooms" are also recognized, although their definition was more problematical. Subsequently, Hill and Hevly (1968) described palynological data that also coincide with the habitation/storage distinction made earlier.

Zilen (1968) and Plog (1969, 1970) used data from the overview unit and surrounding areas in an effort to test the utility of Hill's distinction. Their analysis suggested that, while the size boundary was not absolute, a general distinction between two size modalities was associated with variation in room features at most of the sites in the area. Thus, the habitation/storage contrast seemed secure.

In a subsequent analysis of the relationship between room size and room function, Johnson (1970) found evidence of inter-site variation in average room size in Hay Hollow Valley. Because the average size of rooms on sites varied from site to site, no single quantitative criterion was clearly useful in distinguishing between habitation and storage rooms. However, Johnson did discover two size modalities on the sites he considered and argued that the habitation/storage dichotomy is valid even if there is no single quantitative distinction that is viable for all sites and/or time periods.

Ott (1970) returned to the question of ceremonial vs. secular rooms and ventured into the relatively difficult area of prehistoric ceremonialism in analyzing a series of excavated sites in the Upper Little Colorado and the Pine Lawn area of New Mexico. She compared changing characteristics of the features and artifact assemblages that differentiate kivas and houses.

Her analysis indicated limited evidence of any consistent differences in the artifact assemblages found in kivas as opposed to other structures, prior to about AD 1000. There is also limited evidence of features that differentiate the two classes before this date. The argument is not that there is no basis on which kivas can be defined prior to this period, but only that there is little evidence of strongly developed activity specialization. Interestingly, the change occurred at a time when there is evidence of a substantial increase in the overall degree of specialization in site artifact assemblages and an increase in the ratio of structures on a site to kivas.

Blank, Fischel, and Wild (1974) attempted to identify room types using material from excavated sites in the Purcell-Larson locality. Since there is little variation in room size in the area that is suggestive of a clear habitation/storage dichotomy, architecture could not be used to inform the analysis. They found little evidence

of meaningful variation in quantities or kinds of ceramic artifacts. The most important distinctions concerned the presence/absence of significant quantities of ground stone and the presence/absence of evidence of tool manufacture (as opposed to tool use). All four possible combinations (e.g., with ground stone, without tool use) were discovered. It seems unlikely that so complex a pattern of specialization would have characterized intra-site patterns in the area. The distinctions that were found more probably reflect the last activities that were carried out in the various rooms and/or the nature of trash that was dumped in them.

Acciavatti (1974) provides some notion of the distributional patterns that occur on living surfaces when conditions of preservation are ideal. She analyzed material from rooms 5 and 6 of site 731 in the Purcell Larson locality. These two rooms, apparently occupied at about AD 1275 to 1300, were both burned.

Acciavatti separated the ceramics in the rooms into eating (bowls, ladles, pitchers), cooking (smudged jars), and storage (unsmudged jars) vessels. Limited neighborhood classification analysis was then used to group 1 by 1 meter excavation units on the basis of similarities in the proportions of these different functional categories. There was a tendency in room 5 for storage jars to occur along the walls and cooking and eating vessels in the vicinity of hearths, although there were some storage vessels near the hearths also. Room 6 was somewhat more complex, with a high density of storage vessels throughout the room. Nevertheless, cooking and eating vessels predominated in the vicinity of hearths. Interestingly, there was also evidence that black-on-white, black-on-red, and polychrome vessels are distributed differently, within the room.

Room 6 is somewhat of a puzzle in that it is 60 square meters, atypically large for the overview unit. Acciavatti (1974) observes that there may have been impermanent partitions dividing the room as the hearths are dispersed over it. Vessels may also have been on the roof rather than on the room floor, which was unconsolidated sand. As a result, the charcoal from the burned room simply graded into the sand; there was no clear floor surface. Finally, Acciavatti (1974) notes that sherds from a vessel that was clearly sitting on the floor of one room were found in the other room providing some idea of the magnitude of transformation processes that effect distributions at even the most pristine sites.

## INTRA-SITE SPATIAL PATTERNS

There have been two major analytical traditions in the effort to understand intra-site spatial patterning. The first of these focuses on inferences concerning organizational patterns as these can be inferred from the distribution of artifacts among rooms. The major impact of this tradition has been the development of evidence suggesting increasing specialization of room function and activity structures through time. The second tradition has focused on the "construction cycle" or at least the construction process at sites (see Figures 26 and 27). The major impact of this tradition has been the suggestion that there are regularities in the manner in which sites grow, although these are affected by events that are occurring in the natural and social environment at the time construction is on-going.

Longacre (1966) has argued for differentiation of productive processes at Broken K Pueblo. He notes that while finished products are found throughout the pueblo, tools used in artifact manufacture are, in some instances, highly localized. Graving tools that might have been used in manufacturing bone artifacts, for example, occur largely in the northwestern corner of the Pueblo while arrowshaft tools are localized in the southern portion.

Anderson (1971) attempted to measure variation in the extent of social stratification from the time of Christ until about AD 1400. Her effort is based upon a distinction between "necessary and unnecessary" artifacts and their distribution in the rooms of the Hay Hollow, Gurley, Carter Ranch, Joint and Broken K sites in Hay Hollow Valley. While the distinctions that she made in analyzing the artifact assemblages are somewhat questionable, she describes a way of approaching the problem that is worth pursuing. Her analysis suggests that one cannot exclude the possibility of differential access to resources at any time during the valley's

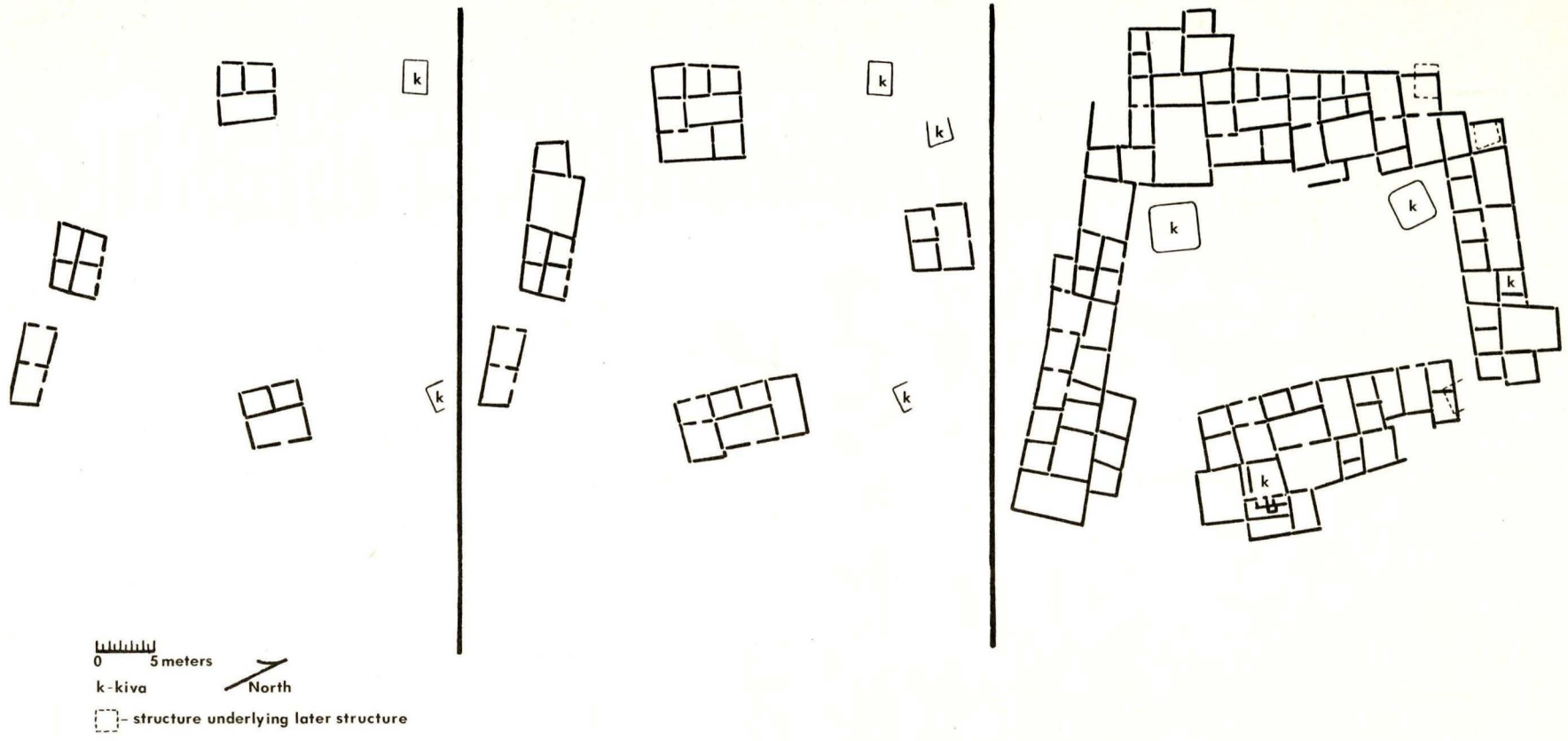



Figure 26. One interpretation of the construction sequence at Broken K.

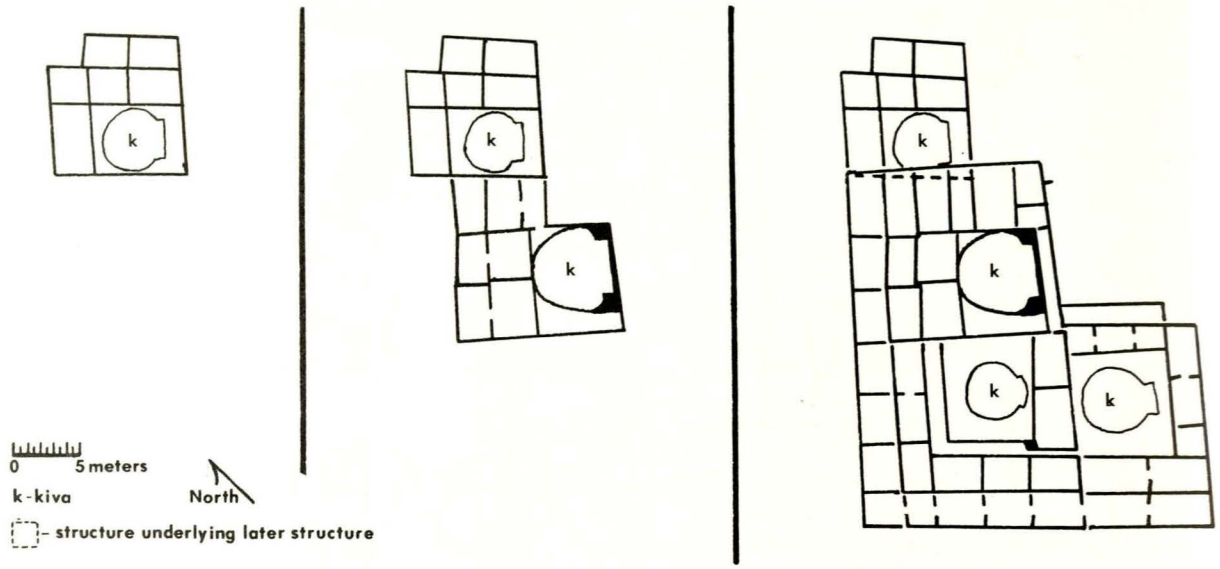



Figure 27. The sequence of room additions at Riatuthlanna.

occupation, although the evidence for differential access is clearly stronger toward the end.

Plog (1974) has discussed a number of different aspects of inter- and intra-site settlement patterning in Hay Hollow Valley. He argues that the features and tools that identify different activity structures within sites vary and suggest a pattern of increasing specialization through time. This change correlates with increases in population and the appearance of a more hierarchical and aggregated settlement pattern within the area.

DeGarmo (1975) has provided a thorough review of the construction sequence and interactive patterns at Coyote Creek Pueblo. He uses information concerning bonding and abutting patterns, trash deposits, and tree-ring dates to argue for construction of different room and room sets at the pueblo at different points in time. These and additional data are then used to construct a convincing argument that just prior to the abandonment of the site most, if not all, of the rooms were still in use.

DeGarmo's major focus is on the domestic and economic organization of the pueblo. He argued that two of the three major room clusters were the abode of domestic groups while the third was a work area. The distributions of tools used in ceramic and chipped stone manufacture, especially those used in manufacturing arrows and chipped stone, suggests some specialization on the part of the two groups. It is possible, DeGarmo suggests, that arrow-manufacture was a specialty for the inhabitants of the sites with members of the two domestic groups subspecialized in the process. Additional suggestions of specialization/exchange include: (a) parts of two bison found in the two domestic areas, and (b) bone tools in one domestic area are made with right-side bones while those in the other are made with left-side bones. There is, also, some differentiation of ceramic design between the two areas.

DeGarmo was not arguing for a substantial degree of specialization. Nevertheless, his careful, perhaps overly cautious, arguments suggest that productive specialization may have been a more pervasive pattern in the study area than the current literature reflects.

Although the recognition that bonding-abutting patterns and other architectural details could yield important insights concerning prehistoric behavior is an old one, this insight has only recently been harnessed to current anthropological theory. The relationships of construction

patterns to stress, to the availability of resources, and to household or domestic cycles have been studied.

Driskell (1969) attempted to discover relationships between population decline/subsistence stress and pueblo construction patterns. He argued that, in Hay Hollow Valley, the average size of rooms declined with population decrease. (Note elsewhere in this section that this is likely a product of an increase in the relative proportion of storage rooms that were constructed.) He does note a number of changes in construction techniques between about AD 900 and 1400, although his argument is based on only four. There was a general decrease in the number of building stones of which walls were composed, as banded or semi-banded walls were replaced by rubble-adobe construction. Walls become generally thinner, the extent to which construction stones were dressed decreased, and the practice of plastering walls decreased. Driskell argued that all of the above represent more economical construction practices as a result of decreased labor availability.

Schaefer (1970) also provided an analysis of the growth curve at Broken K. He was particularly concerned with the relationship between private and public space. The public space in question is essentially the plaza which is bounded by the dwelling units. Even the earliest few rooms seem to have bounded a plaza. While some of this "implicit plaza" was eventually used as the pueblo grew, the basic growth pattern at the site is outward from the plaza around which the first few room clusters at the site were built (see Figure 26).

Autry and Vaughan (1972) analyzed the settlement patterns of Hooper Ranch, Table Rock, Mineral Creek, Rim Valley, Carter Ranch, Broken K and the Joint Site pueblos. Their analysis began with an effort to describe the architectural history of the sites through a detailed analysis of bonding-abutting patterns. Having completed this analysis, they defined residential clusters, groups of rooms of different types that seemed to represent additions to an initial core group of rooms. They then attempted to determine whether variation in the nature of these clusters from site to site was best explained in terms of environmental stress or domestic group dynamics. They note two trends. First, there was a regular construction sequence at all sites with an initial heavy investment in the construction of habitation rooms, followed by the construction of proportionally more storage than habitation space. Then there was a return to relatively more construction of proportionally more storage space followed by a return to relatively more construction of habitation space. Second, there was a general overall increase in the construction of storage rooms during periods of time when the pollen records suggest that stress might have occurred in the area.

The first pattern might be either a generational one or related to the stress. It could reflect the construction of habitation rooms sufficient to underwrite the expansion of a nuclear family, followed by storage rooms necessary for the foodstuffs required to sustain children, followed by the construction of new households. Alternatively, it could reflect an initial settlement the inhabitants of which construct additional storage space during a time of stress and then ultimately resolve the problem by enticing more inhabitants/laborers to the settlement.

One equally important point on which the authors (Autry and Vaughan 1972) do not comment is the substantial variation in the size of the residential clusters at all sites. The ratio of the largest to the smallest cluster at each site is between about 3:1 and 4:1. In one instance the difference is due to a greater quantity of storage space in the largest cluster, in two cases it is due to a greater quantity of habitation space, and in one the relationship is proportional. Thus, while both economic (storage) and social (habitation) factors can account for the difference, the possibility of a status-based explanation for variation in cluster size seems likely in at least two cases.

Tracz (1970) used formal analysis in an effort to understand variation in the rules that described construction techniques in different sectors of the Joint Site. Her analysis focused on 15 attributes of the rooms, ranging from area to such detailed attributes as presence/absence of pottery in the walls. Her analysis suggested that it is possible to describe different sectors of the pueblo that were built according to different rule sets. Whether these are ascribable to temporal or social

variation is unclear. Nevertheless, the study suggests the potential of efforts to define residential clusters, or at least clusters representing an epoch of construction, on the basis of detailed attributes of the rooms.

Wilcox (1975) has summarized the architectural history of the Joint Site in Hay Hollow Valley. His analysis rested on a careful treatment of bonding-abutting patterns, the surface on which particular rooms rested, and tree-ring dates. He argued that the site was initially occupied by three social groups and that the later history of the site reflects expansion of these groups. Although the rate cannot be determined, the site grew as a result of aggregation and not a massive and planned labor investment. This essay probably provides the best available model for the analysis of the architectural history of relatively large puebloan sites.

Wilcox (1975) has also analyzed the architectural history of Broken K. His work supports the notion that each of the four main room blocks grew from a small core of rooms. Thus, the "plaza" was defined from the very beginning of the site.

A regular alternation in the construction of habitation, storage, and/or habitation/storage combinations is evident in the various room blocks. The number of rooms constructed does vary between room blocks. Contemporaneity of construction is uncertain. At precisely the same points in the construction sequence (but again not necessarily contemporaneously) large clan rooms are added in each wing. This pattern is strongly suggestive of one that would result from the relatively regular growth of family units in each of the four room blocks. Habitation rooms were added when children left their natal residence. Storage rooms were added to accommodate more children. After some critical density was reached, a clan room was added for meetings. There is, of course, the alternative possibility that some of the storage rooms were added to meet environmental problems, and that the addition of clan rooms reflects organizational change with little relationship to the household dynamics of the pueblo.

Hanson (1975) has argued that a major change in occupation pattern occurred near the end of occupation at the Joint Site in Hay Hollow Valley. Early in the history of the site, there was a very typical dwelling-living unit that consisted of a habitation room (firepit), preparation room (mealing bin and/or mano-metate complex), and a storage room (featureless). The last rooms constructed at the site were larger, multi-functional rooms. Hanson suggested that the experimentation and economy reflected in these rooms are a response to stress. It is worth noting, however, that the clear-cut room function pattern that seems to be common in the Upper Little Colorado is less common in surrounding mountainous areas. Thus, this change could represent the adoption of a different architectural style.

## FUTURE RESEARCH: ROOM TYPE

While the ability to distinguish between habitation, storage, and ceremonial rooms provides an important analytical basis for studies of intra-site settlement patterning in the study area, there are a number of areas in which our understanding is less precise than it should be.

The room size/room function equation seems to work best in the plains portion of the overview area. In the more mountainous areas, a bimodal distribution of room sizes is not apparent. Thus, activity structure in sites that are composed of these multi-functional rooms is relatively poorly understood.

While the habitation/storage dichotomy is now relatively well understood, the secular/ceremonial distinction is not. Watson Smith's thorough discussion of "kiva-ness" (1952) has made it clear the "kiva" features are not exclusively associated with this architectural form. No study of variation in the presence of kiva features with respect to architectural types, not to mention an assessment of the strength of covariation, has occurred in the overview unit. Thus, the degree of distinctiveness of ceremonial units is problematical.

Little effort has been invested in recent years in the study of construction techniques. It is clear that Chaco, Mesa Verde, and Kayenta "styles" are all present within the area and that more than a single style can occur at one site. Jacal and possible adobe architecture are also found.

Because little effort has been expended in a badly needed study of the overlap of these different styles, it is not possible to use them in studies of either spatial or temporal patterning.

Clan rooms remain somewhat of a mystery. Exceptionally large rooms occur on even quite small sites and seem to contain relatively distinctive artifactual assemblages, a point to be discussed later. Nevertheless, there is at present no good definition of such rooms, not to mention an evaluation of their function. The same comment holds for "mealing rooms," rooms with stone boxes and/or metates set into the floor. These are evidence of the first clearly specialized processing space in Southwestern sites. Yet, no study to date has compared them with respect to size, attributes of architecture, or space-time distribution.

## PATTERNS AND PRINCIPLES OF SETTLEMENT LAYOUT

There is no easy way to summarize these specific studies in terms of a few predominant sites types. However, for the pithouse and pueblo periods some synthetic statements are possible. Because pithouse data are more limited, these will be considered in some detail with a focus on broader principles for the Puebloan sites.

Gladwin's (1945) description of the White Mound type provides evidence of a very typical settlement pattern and architectural form that occurs throughout the overview unit, although not at all sites. White Mound Village was a series of clusters consisting of a variety of combinations of pithouses and surface structures. The pithouses varied considerably in shape, from circular to subrectangular. While the surface rooms were generally rectangular, there is considerable variation in size and the presence/absence of "basins" inside the structures. Somewhat larger houses with benches that may have been kivas are also present. Structures with and without hearths and with and without V-shaped walls emanating from the hearths were recorded. The general pattern of the settlements was a line or arc of surface, probably storage, structures around a cluster of pithouses and a single possible kiva.

Sites that are virtual mirror images of this one occur elsewhere in the overview unit, as far south and west as Wild Cat Canyon near the Forest Development Road 504. While excavation has been done at only a few other sites, surface indications suggest a White Mound pattern. Invariably the sites, or perhaps better, multi-site communities, are among the largest in the areas where they occur. Thus, there is a strong suggestion that these may have been ritual, economic, or political centers and that their distinctive characteristics are a reflection of functional patterns rather than temporal patterns.

The Flattop Site (Wendorf 1950, 1953) is a pithouse village located in the Petrified Forest. The site consists of 25 structures on top of a mesa. Eight of the houses at the site were excavated. Only one of these had a hearth and only one a firepit. The houses were generally about 35 centimeters deep and 2.5 to 3 meters in diameter. All were slab-lined and were circular to oval in shape with an inclined entry way. Some corn was recovered from the site. A relatively large ceramic collection from the site was entirely Adamana Brown.

The Twin Butte Site, also in the Petrified Forest, was described by Wendorf (1951, 1953). The site is probably best viewed as one settlement in a multi-site community because there are several other nearby sites as well as suggestions of water control features. Eight, of a total of twelve, structures were excavated. Both surface, semi-subterranean, and subterranean structures occurred on the site. These are variable in size, shape, and depth. The living structures and storage cists occur both individually and in crescentic groups around "kivas". Eight burials at the site contained shell ornaments, turquoise, and argyllite. There is variation suggestive of status differences. Corn was recovered from some of the storage cists. Lino Grey, Woodruff Brown, Lino Black-on-Gray, and La Plata and White Mound Black-on-White were the major components of the ceramic assemblage, suggesting a Basketmaker III occupation of the site.

Three, of a possible total of four, houses were excavated at the Tumbleweed Canyon Site (Martin et. al, 1962). The structures varied from circular to D-shaped. All of

the houses were lined with basalt boulders and all had hearths, although only one had a storage pit. No ceramic artifacts were recovered from the site, but a single radiocarbon date suggests occupation at about AD 300.

Gumerman (1966) excavated two pithouse sites near Houck. NA 8937 consists of oval pithouses that average 60 centimeters in depth and 4.5 meters in diameter. The houses all had hearths on a gently sloping, unprepared floor. The absence of interior postholes suggests a sloping self-supported roof. The house contained no internal storage pits. A single Cibola White Ware sherd, believed to be intrusive, was recovered from one of the houses. Four pithouses were excavated at NA 8971. While these were also oval in shape they were on the average smaller (3.75 meters) than those at NA 8937. The structures contained hearths, postholes, and, in two cases, meter deep storage pits. Pueblo II ceramics were recovered from the fill and again identified as intrusive. Corn pollen was recovered from sediments at the site. Radiocarbon determinations were deemed "worthless" at the time and were not reported. Given subsequent evidence of the late occurrence of pithouses in the area, it is entirely possible that these sites may represent late aceramic manifestations, although the basis for arguing a Basketmaker II association is evident.

The Finger Rock Site (Gumerman 1979) is north of Winslow, actually outside of the overview unit proper. Both rectangular and circular structures are present on the site with a diversity of floor features. The pottery is predominantly Lino Gray, but both Lino Black-on-gray and White Mound Black-on-white are present. Some later ceramics suggest that there may be more than a single occupation at the site. In this regard, the site is a classic illustration of the problem of determining whether one is dealing with a single multifamily settlement or a series of sequential occupations of a particular location.

The Connie Site (Thompson and Longacre 1977, Rogge, in prep.) is located on a point of a mesa in Hay Hollow Valley. The site consists of 35 pithouses, 11 "smaller structures," 6 features bounded by a cobble arc, and 1 probable kiva. Seven houses excavated at the site were relatively uniform. They were 4 to 5 meters in diameter and about 30 centimeters deep. All were rocklined. Hearths were generally present along with a vertical deflector slab. In a general sense, the houses are arrayed in an arc around the probable kiva. The site is radiocarbon dated to about AD 225, although there is an archeomagnetic date of AD 650 and 690. Pottery from the site is uniformly Adamana Brown. The Connie Site has a companion site, NS 243, on the same mesa top. The architectural characteristics of the site are similar, and the ceramics identical. In general, there are many similarities to the Flattop Site, although there appears to be somewhat more of a village pattern.

This list by no means exhausts the total of excavated pithouse sites in the overview unit. These do represent the larger and more complete projects. Reports on the excavation of a single pithouse allow little opportunity for the discussion of diversity. Some pithouses and pithouse sites are shown in Figures 28 and 29.

A number of "patterns" can be described on the basis of the data that have been reviewed. I use the term pattern because I do not wish to leap to the conclusion that these represent either temporal or spatial units. First, architecturally, there are four patterns that we may refer to as the Adamana, White Mound, Finger Rock, and Mogollon patterns. The Adamana pattern is that expressed at sites such as Connie, Flattop, and Tumbleweed Canyon. All of these are mesa top sites and the structures are rocklined. This is not to say that there are no differences between the sites. The houses at Connie and Tumbleweed, for example, have hearths while those at Flattop do not. Connie and Flattop have Adamana or Woodruff Brown pottery while Tumbleweed has none. But, there appears to be a basic similarity in the location and architecture of these sites. Their spatial distribution appears to be to the east of Silver Creek (which is interesting in light of the preceeding discussion of the distribution of Desert Culture projectile point styles). There are no records of such sites further south than Hay Hollow Valley. They may well occur further northward and eastward than the boundaries of the overview unit. Temporarily, their placement is a problem. Connie may date to either about AD 200 or AD 600. Tumbleweed Canyon dates to about AD 300. Flattop has been dated to AD 300 on the basis of the occurrence of Adamana pottery in Hilltop phase contexts at the Bluff Site, a chronological argument

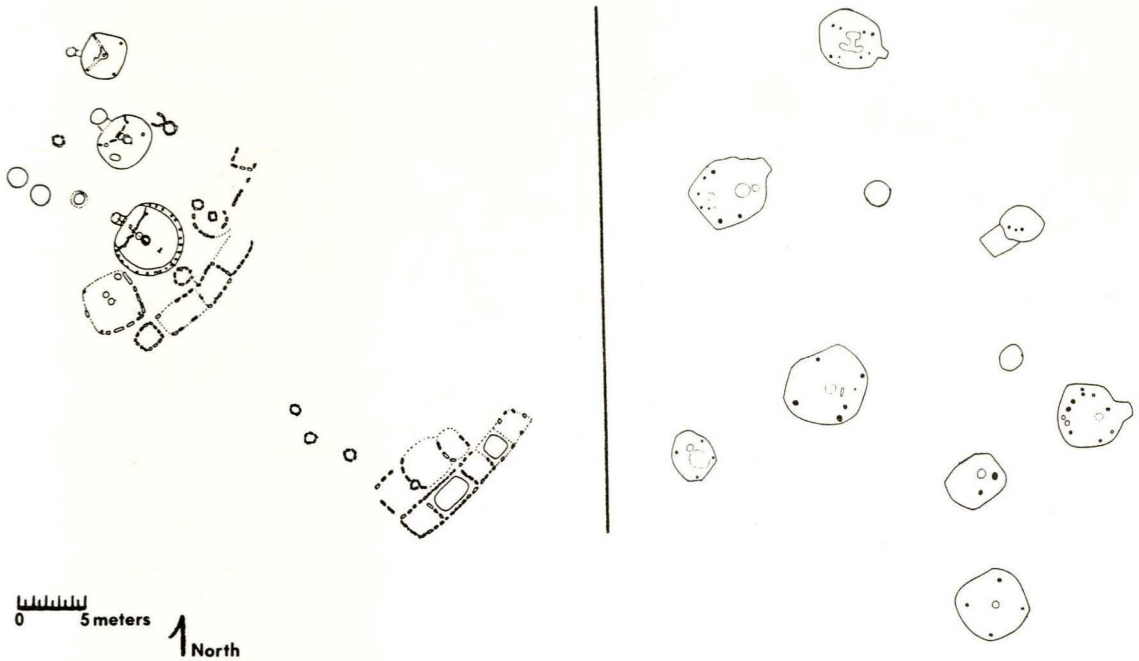



Figure 28. Variation in the plan of pithouse villages in the Little Colorado overview unit.

that Gladwin (1948) has questioned in rather telling fashion.

The White Mound pattern is expressed at White Mound, the Whitewater Sites, and Twin Buttes. It consists of relatively deep pithouses with rather consistent floor features along with surface living and storage rooms. Again, while sites are by no means identical, the homogenity is striking. In fact, I would suggest that there is more similarity among White Mound sites than any other widespread architectural tradition in Southwestern prehistory. Spatially, such sites barely cross the rim at Walnut Creek (Morris 1970), clearly extend northward and eastward outside of the overview unit and may occur beyond the westernmost boundary also. Well-dated sites seem to suggest that this pattern was characteristic between AD 700 and 1000.

The Finger Rock pattern is defined by the absence of a pattern. These sites are characterized by enormous architectural variability, but usually appear to be small, on the order of four or five rooms. There is no clear evidence that the structures are contemporaneous. In this sense, the sites might represent no more than the periodic occupation of a desirable hunting, gathering, or farming location by a family-size group or the coming together of peoples with distinctive technological traditions in a small village. These sites occur throughout the overview unit. Temporal placement is difficult, although the Gurley Sites in Hay Hollow Valley, a classic example of the pattern, date to AD 500 and AD 1000.

Pueblo period village patterns are far more difficult to synthesize (see Figures 26 and 27). First, there are many more sites that have been excavated or mapped. Similarly, it is far easier to record the pattern of Puebloan sites on survey than is the case with pithouse villages. Second, once above ground masonry construction had become common, the prehistoric engineer-architects had available an almost unending array of different combinations that could be employed in constructing sites. Most of these options appear to have been used in one circumstance or another. For this reason, it is far easier to identify the principles that underlie the variation than any set patterns. Apart from obvious variation in size, there are four major principles: aggregation of rooms; association of kinds of rooms; focus; and planning.

Puebloan sites within the overview area vary incredibly in regard to the extent of aggregation of rooms (Figures 30 and 31).

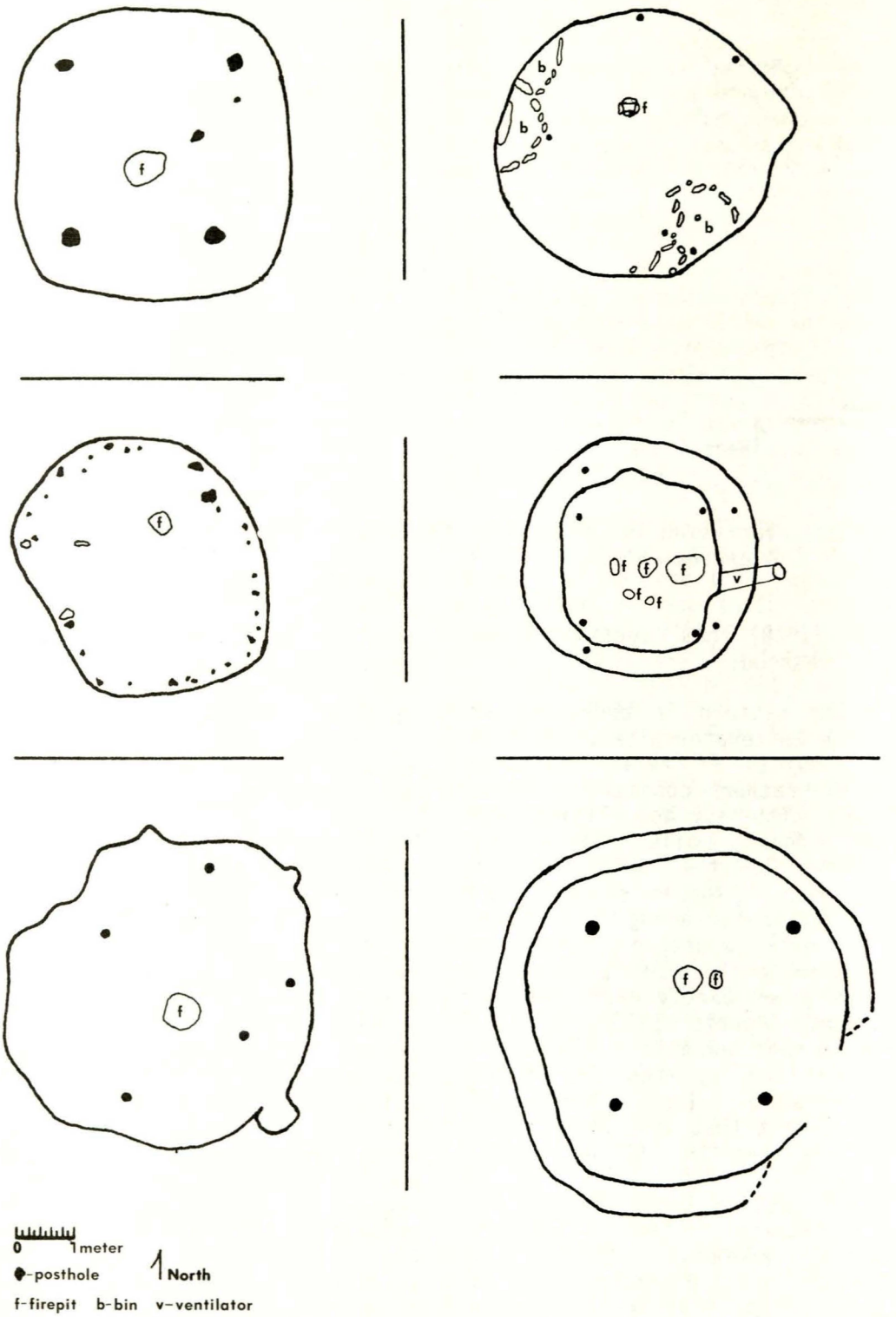



Figure 29. Variation in pithouses in the Little Colorado overview unit.

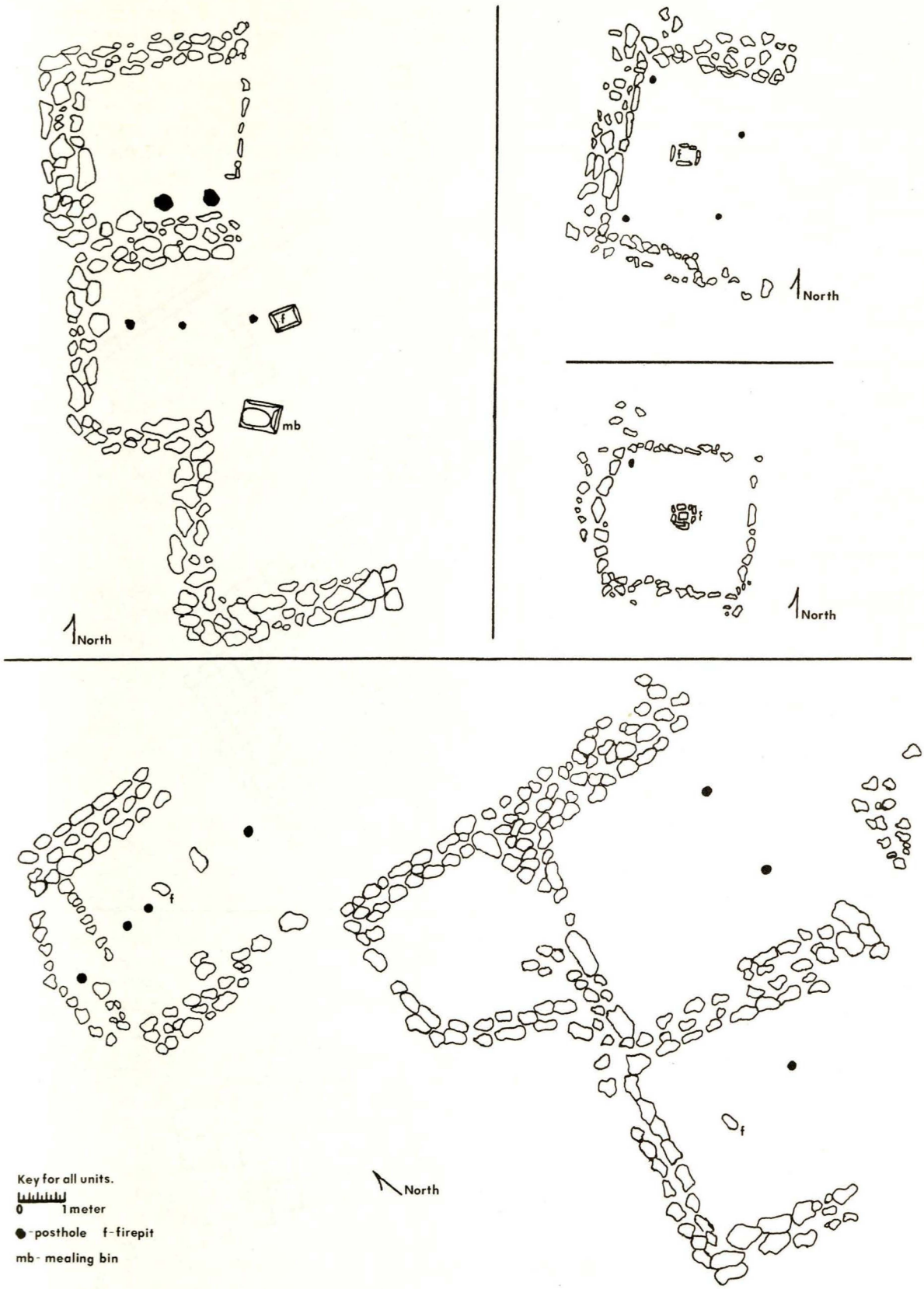



Figure 30. Variations in the plans of small pueblo sites in the Little Colorado overview unit.

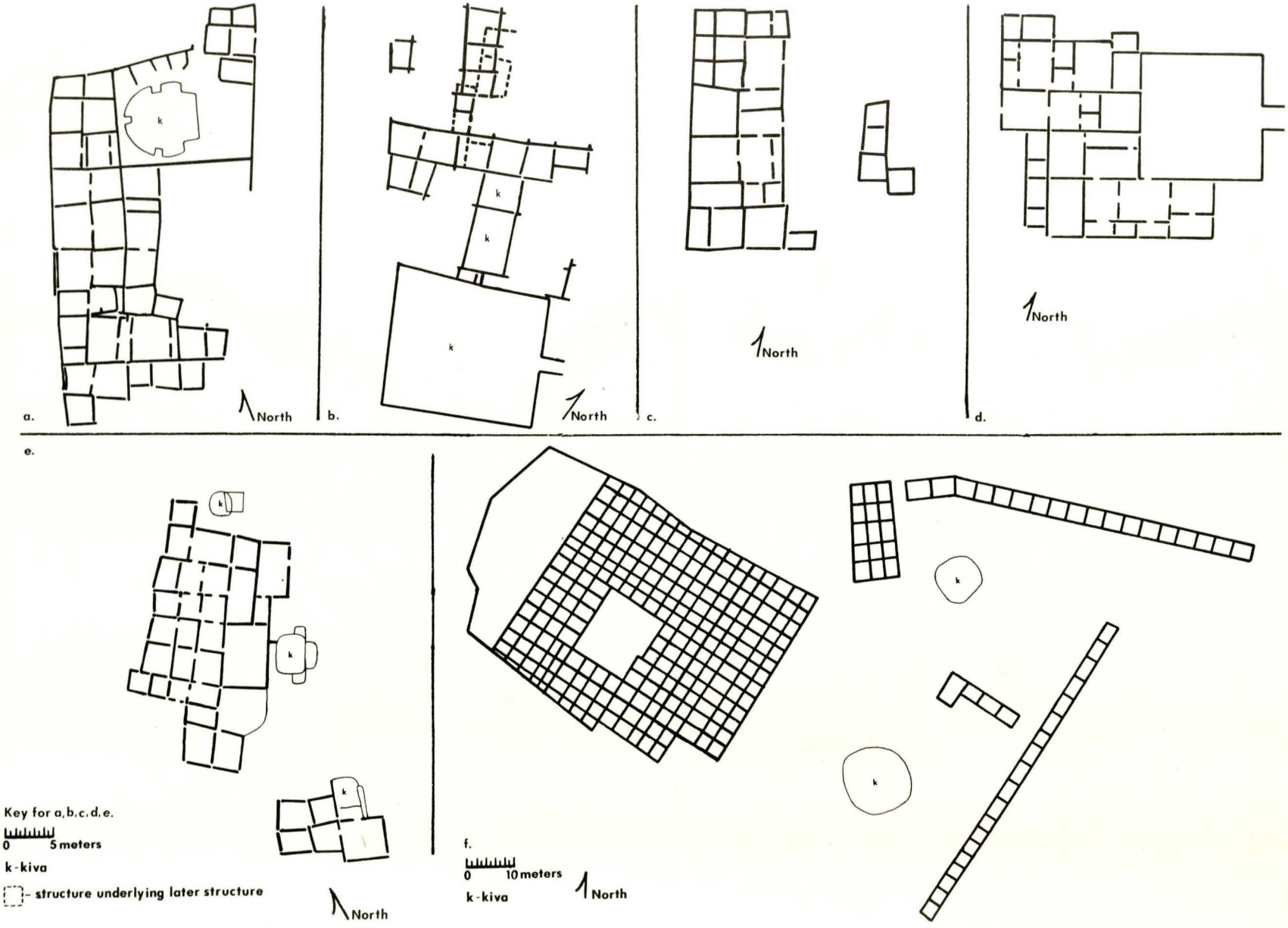



Figure 31. Variations in the plans of larger pueblo sites in the Little Colorado overview unit.

Aggregated sites are ones on which the rooms occur in one or several contiguous blocks. Disaggregated sites are ones on which the rooms occur as isolates. I know of very few completely disagregated sites that have more than just a few rooms. The largest disaggregated sites are several in the Purcell-Larson drainage that range in size from one dozen to two dozen rooms. Aggregated sites may be quite small. There are many examples in the overview area of "unit pueblos," or at least sites that resemble unit pueblos. These are composed of blocks of four rooms. The very largest sites in the study area are generally aggregated. Of course, there are many examples of sites that vary between these two poles. Even the largest aggregated sites often have a few outlying rooms. And, there are some sites, site 689 in the Chevelon drainage is an example, that are composed of a single aggregated room block with an equal number of individual outlying rooms.

On aggregated sites, the manner in which particular rooms are associated also varies. The predominant pattern is one in which habitation, storage, and kiva rooms are associated in a complex fashion. Broken K (Hill 1970) and Carter Ranch (Longacre 1970) are examples of this pattern. Another pattern is one in which storage rooms occur in association with kivas. Site 201 (Zubrow 1975) in Hay Hollow Valley is an example of this pattern. Kiathuthlanna (Roberts 1931) shows an association of storage rooms with kivas, the former surrounded by a ring of habitation rooms. In the Chevelon drainage, the definition of room types is an almost impossible task since room sizes vary little within sites. Thus, exploration of this principle is not always possible.

The focus of Puebloan sites refers to the feature around which rooms appear to be aggregated or dispersed. It is of course difficult to discuss this issue in the case of very small sites. In the case of larger ones, it is meaningful to distinguish between plaza, kiva, front, and compound focused sites. Plaza-focused sites are ones such as Broken K (Hill 1979) where the construction of rooms appears to have occured around a plaza. At Kiatuthlanna, a kiva is the focus of each of the major construction units (Roberts 1931) and a series of kivas are, thus, the foci of the site. Front oriented sites are ones on which entrances all appear to face in a single direction. In a sense, the space outside such units is an unbounded plaza. Finally, sites such as those described by Gumerman (1960) and Gumerman and Skinner (1968) near Holbrook are constructed within a compound. In the case of very large and complex sites, multiple foci may be present. At Pinedale Ruin (Haury and Hargrave 1931) there are both compound and front focused components to the site. To a minimal extent, one can talk about focus in the case of disaggregated sites. In the Chevelon drainage, for example, great kivas appear to occur in the center of clusters of smaller sites.

Finally, Puebloan sites vary in the degree to which they are planned. In general, planning refers to the presence of a focus for the site and to some evidence of cooperative effort in erecting at least portions of the site. However, the specific evidence of planning is highly variable. As we saw at Broken K, planning could have involved little more than an implicit notion of public space, the idea of a plaza, with the construction of particular rooms around the plaza appearing to represent discrete construction events or clusters of events. At Kiatuthlanna, construction apparently occurred in larger units. At this site most of the room walls in major architectural units seem to have been erected relatively simultaneously. At still other sites, a combination of cooperative-planned and individual construction seems to have occurred. Walls oriented in one direction were sometimes constructed at a single time using a single masonry style. The perpendicular walls that abut these show highly varied construction techniques, probably the result of individual family or clan efforts. I know of no excavated site within the overview area done in precisely this fashion. It was the technique used at Nuvaqueotaka, just outside of the overview area.

## FUTURE RESEARCH: PATTERN AND GROWTH

At present, few generalizations can be drawn from these studies--they are simply too few in number and too restricted to a limited sector of the study area. However, a clear case has been made for the careful analysis of construction techniques and sequences at <u>all</u> future excavated sites in

the overview unit. Such data could be used in the following sorts of analyses.

While most of the sites discussed above appear to have grown from relatively slow accretion, there are departures from this pattern. The site of Kiathuthlanna, for example, appears to have been built in highly planned segments. At Broken K, the existence of the plaza seems to have been implicit in the very earliest stage of construction at the site. The difference between planned and unplanned sites is a critical one since the former implies a degree of labor control or coordination that the latter does not. It is unclear whether planning was characteristic of some sites at all time periods: if this were true, these sites would probably be important central places or distinctive of particular time horizons. This would imply greater local organization but not necessarily centrality. Clearly this information is necessary to understanding the prehistory of the area.

The nature of residential clusters and of their growth sequences must be better understood. Of primary importance is an effort to combine studies of stylistic variation in ceramic materials and of functional or stylistic variation in other artifacts with residential data. The only study to date that approximates this approach is that of DeGarmo (1975). Not accidentally, his provides the most thorough evidence for the existence of both domestic groups and task specialization. Status differences among residential clusters remain largely unexplored. Statistical "pattern searches" are less likely to yield valuable results when they are applied to site space as if it were undifferentiated when, in fact, architecture can be used to provide a structure on which statistical analysis can be framed.

Detailed control of the epochs during which rapid construction of storage rooms occurred is vital. At present, it is equally likely that these reflect either a change in subsistence strategy associated with greater numbers of people living at sites, or a change in organizational strategy, with some sites serving as storage/redistributive centers, in a response to stress. Of course, these possibilities are not mutually exclusive. But the substantial variation in the construction of storage room through space and through time is an intriguing phenomenon that will certainly yield valuable insights.

Changes in construction techniques present a similar problem. Where detailed studies have been done, as at Broken K and the Joint Site, there is obvious variation. As noted earlier, the magnitude of this variation can even extend to include the presence of more than one of the traditional Southwestern styles at a single site. Whether such variation represents the degradation or improvement of construction techniques in response to environmental change, migration, or other social dynamics cannot be stated at present.

Analysis of wall bonding-abutting patterns at sites where dates can be assigned to different construction epochs is an obvious need.

# SETTLEMENT PATTERNS: INTER-SITE

In the preceding section, on-site settlement patterns were considered. In this one, relationships between discrete sites are the focus. In general, inter-site studies rely heavily on observations of the surface conditions of sites rather than on excavated materials. In some cases to be considered the latter are used, but they are rare. Nevertheless, inter-site studies are clearly dependent to a very substantial degree on a thorough understanding of intra-site patterns and on the manner in which particular of these patterns are, or are not, manifested on site surfaces.

## ELEMENTS OF INTER-SITE PATTERNS

There are probably few concepts in archeology that are more problematical than that of site type. The difficulty with the term reflects two considerations. First, as archeological sophistication in making inferences concerning behavior and activities in the past increased, acceptable levels of detail for defining site types increased. Second, success in defining site types is considerably dependent on the profession's ability to relate key pieces of surface information to subsurface deposits.

No effort is made here to generate a detailed definition of site types for the area, one that reflects behavior and activities. Instead, the discussion will focus on surface artifacts and surface features. While such an approach leaves much to be desired, site types defined even in this crude fashion present difficulties. The first topic of discussion will summarize efforts to define more specific site types in response to a variety of management and research problems. The second identifies studies that have been done in an effort to refine definitions of functional variation among sites.

### Low Density Artifact Scatters

Low density artifact scatters, commonly termed "non-sites" in the literature, are different from prehistoric sites. Sites are discrete and interpretable loci of cultural materials. Low density artifact scatters lack the quality of discreteness and may also lack interpretability. They are relatively large areas characterized by a low density of artifactual materials, often less than one artifact in a 10 square meter area.

### Lithic Scatters

Lithic scatters are defined by the exclusive presence of chipped and ground stone artifacts. Known sites of this type in the overview unit range from 1 square meter to over 1000 square meters. Their precise interpretation is at present unclear because two very different patterns of human behavior generate such sites. As mentioned earlier, prior to approximately AD 1, Southwestern peoples did not manufacture ceramic artifacts. Therefore, the sites reflecting their presence are almost exclusively lithic sites. Even after Southwestern peoples made and commonly used ceramic artifacts, some of their activities were carried out at loci where ceramic items were not a necessity--butchering and hunting camps are examples. Differentiating between these two behavioral patterns is extremely difficult, and analyses undertaken to date have proven unsuccessful (Slawson 1978).

### Ceramic Scatters

Ceramic scatters are defined by the exclusive presence of ceramic artifacts. In general, the presence of ceramic materials allows assigning at least a rough date to such manifestations. These sites are generated by prehistoric human activity that, in respect to nonperishable artifacts, involved the exclusive use of ceramic containers. Such containers were used for cooking, for the storage of water, and for the storage and processing of foodstuffs. They may also have been used as boundary markers for the fields or lands associated with a particular settlement.

### Artifact Scatters

Artifact scatters are defined by the presence of lithic and ceramic artifacts. These sites are generated by at least three distinctive patterns of human behavior.

First, they are produced by resource extracting behavior requiring the use of chipped and ground stone and ceramic artifacts in collecting resources. Second, they are generated when a locus is used for habitation but the habitation structures were so ephemeral in character that they leave no surface evidence. Third, they are generated when permanent habitation structures are obscured by later natural and cultural transformation processes. Preliminary analysis indicates that the majority of these artifact scatters in the study area are associated with activities other than habitation since their artifact inventories are distinct from those of habitation sites (McAllister and Plog 1979).

## Petroglyphs/Pictographs

Petroglyphs are drawings made on rock surfaces by pounding those surfaces with a hard instrument to create a pattern. Pictographs are made on rock surfaces using pigments (see Figure 32). There are many known petroglyph and pictograph sites in the overview unit. These sites may reflect the efforts of prehistoric peoples to communicate with one another, or may be simply aesthetic expressions. Some scholars argue that these sites can be dated, while others question this claim. Some argue that the drawings are interpretable, others disagree. That the sites can yield valuable information is indicated by one glyph in the vicinity of Chavez Pass Ruin on the Coconino National Forest. This glyph is a presentation of Quetzalcoatl, a Meso-American god. In this instance the particular representation of Quetzalcoatl is one that is sacred to stone workers. This discovery illustrates the possibility of drawing symbolic connections between peoples of different areas using the rock art.

## Water Control Devices

Southwestern peoples used reservoirs, irrigation ditches, terraces, gridlines, and check dams as mechanisms for water and soil control (see Figures 33 through 38). Examples of each are known from the study area. Terraces were constructed by placing rocks on top of one another to a height sufficient to level the land surface behind the terrace. Gridlines are also lines of rock, usually only a single course in height, aligned to closely follow the contour of the land surface. Contour plowing is the closest modern analog to gridding. Check dams are defined by rock alignments, usually one but sometimes more courses in height, placed across stream channels perpendicular to the flow of the stream. These served to slow the flow of water through the channel, reduced erosion by capturing soil suspended in the stream water, and increased the level of ground moisture in the channel.

## Shrines

Shrines are a category of cultural resources the definition of which is somewhat of a problem. They normally are defined as low stone walls enclosing a circular or quadrilaterial area on the order of one or a few square meters. A shrine may consist of several such arrangements. Beads, ceramics, and chipped stone artifacts and a variety of esoteric materials may be associated with shrines. In the study area, shrines occur at high altitudes--on mountain peaks and overlooking the headwaters of major drainages.

## Rock Shelters

The earliest "roofed space" that existed on the National Forests were rock shelters, erosional cavities in cliff faces that were used for perhaps occasional, perhaps permanent, human habitation. A large and a small rock shelter are shown in Figures 39 and 40. The most common occurrence of these features is in the larger and deeper canyons, Chevelon, Wildcat, and Brookbank, but they are also found elsewhere on the National Forests. These sites represent particularly important cultural resources because they often contain stratified deposits that yield information concerning changes in prehistoric behavior through time. Also, materials such as basketry and cloth not normally preserved in Southwestern sites are preserved in rock shelters (see Figure 41).

## Pithouse Sites

Prior to about AD 1000, most habitation or living sites occupied by Southwestern peoples were pithouse villages (see Figures

Figure 32. Pictographs in Chevelon Canyon.

Figure 33. Agricultural terraces at Nuvaqueotaka.

Figure 34. Check dams in the Chevelon area.

Figure 35. Cleared field, Hay Hollow Valley.

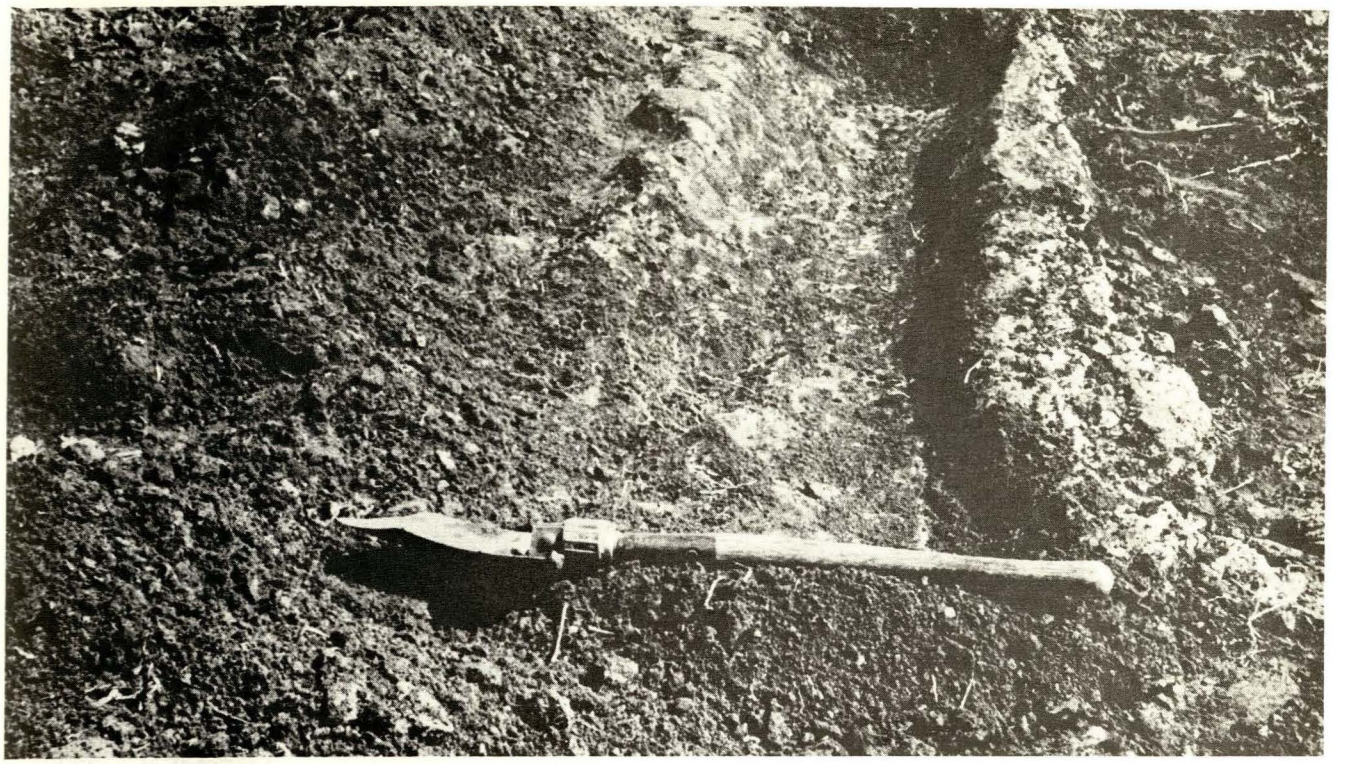


Figure 36. Fossilized canal segment near St. Johns.

Figure 37. Vegetation marking buried irrigation ditch in Hay Hollow Valley.

42 through 44). Pithouse is a term that covers a multitude of sins. Some Southwestern pithouses are only a few dozen centimeters in depth while others are over 2 meters deep. Nevertheless, with rare exceptions, pithouses were built by erecting timber supports in a pit, laying branches and/or reeds against these to form walls and roofs, and covering these with dirt or adobe.

Pithouse sites are relatively difficult to identify, especially when the houses in question were relatively shallow. Their presence can be indicated by some combination of circular depressions, circular vegetation patterns, circular patterns marked by the absence of vegetation, circular configurations of wall stones or cobbles. Pithouses may be present on sites without any substantial surface indications.

## Pueblo Sites

Pueblo sites are defined by evidence of above-ground masonry architecture (see Figures 45 through 49). These sites are characteristic of Southwestern peoples after about AD 1000, although there is substantial evidence that some peoples residing in the study area continued to live in pithouses well after this date. Pueblo architecture is markedly diverse. "Field houses" (Pilles 1979) are marked by a simple pile of boulders covering an area of several square meters. The associated artifact density is typically quite low. These structures were probably used seasonally in association with plant cultivation activities in fields.

Small U-shaped structures of one or two rooms are characteristic at higher elevations in the study area. The artifact density associated with these structures suggests that occupation at the sites, or at least the production of artifacts, was far greater than at field houses.

True "pueblo" architecture has four full standing walls. In the overview unit, these sites also typically average about two to four rooms. Their artifact inventories suggest, however, that they may have played a distinctive role in trade or exchange relationships within the area.

Figure 38. Irrigation ditch revealed in cross-section by archeologist's excavation.

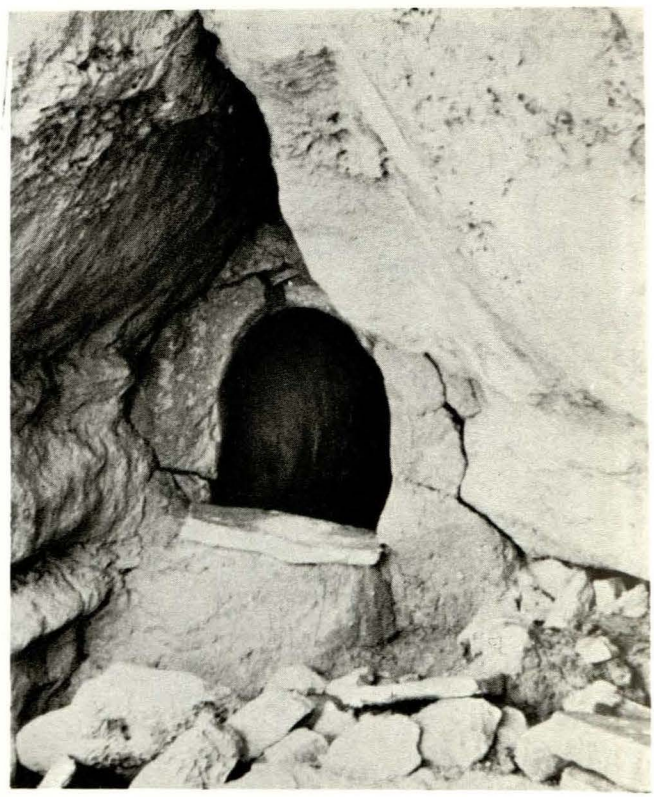


Figure 39. Adobe-walled granary M. Chevelon Canyon.

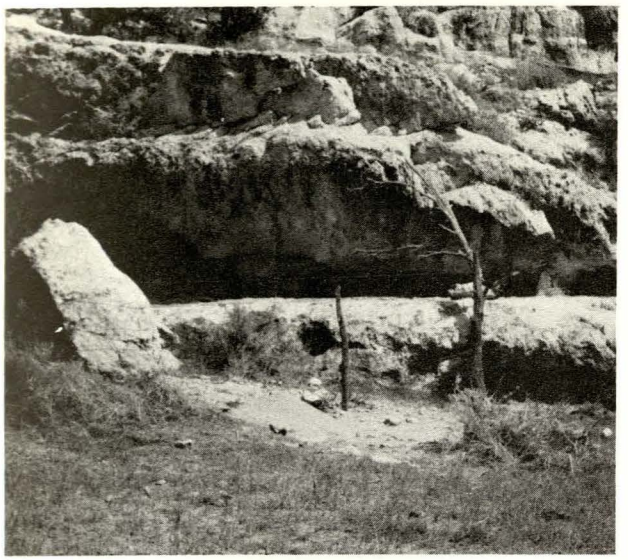


Figure 40. Rock shelter in Brookbank Canyon.

Figure 41. Baskets from rock shelter in Chevelon Canyon. Each measures about 20 centimeters in diameter.

While both U-shaped and true pueblo sites are typically small, there are larger examples. Within the overview unit, the largest known site of U-shaped structures has roughly 40 rooms and the largest true pueblo has about 400 rooms.

### Great Kivas

Great kiva sites are defined by the presence of large (ca. 15-25 meters diameter), usually circular depressions. These sites represent the centers of ceremonial activity among prehistoric peoples. Great kivas sometimes occur as features on pueblo sites, but they also occur in total isolation. While their principal importance was ceremonial, these sites also seem to have served as important centers of exchange and trade.

### Compounds

Compounds are a completely enigmatic site type. They are defined by substantial masonry walls enclosing rectangular areas between approximately 300 to over 1000 square meters. The artifactual assemblage of such sites is generally quite different from that of contemporaneous sites, although the manner in which such sites differ is highly variable. While their precise role in regional settlement systems is currently unknown, they too apparently served as centers of trade and exchange within the study area.

### Defensive Sites

Attribution of defensive characteristics to sites has waxed and waned in the literature. When this concept has been criticized, attention has been directed to the casual manner in which the term has been used, sometimes in reference to sites that are on a moderate hill (Figure 50). Nevertheless, there are sites in the overview unit that can be defined as defensive based on relatively firm criteria. These sites have one or more of the following attributes: 1) an inaccessible location--reaching the site involves a difficult climb taking at least several dozens of minutes; 2) low visibility--the site can be seen from only a relatively few points in the surrounding area, if at all, and; 3) defensive walls--(Figure 51) there are examples in the overview unit of walls bounding a site that are up to 3 meters in height and 2 meters in thickness.

## ANALYSES OF SITE TYPES

Johnson (1970) provided a number of useful insights concerning local settlement

Figure 42. Pithouse site in Chevelon Canyon. The surface is marked by ground stone and upturned cobbles and boulders.

Figure 43. Woodruff Butte site. Houses are marked by substantial stone circles.

patterning. His data are from Hay Hollow Valley. He was particularly interested in the possibility that sites in different environmental niches were involved in different exploitative activities and that there were central places in which these productive activities were integrated. The results of his analysis do little in respect to the first claim. However, in regard to the second, he suggests that: 1) larger and more central places had twice as many storage rooms as surrounding sites; 2) sites generally occur in discrete clusters with one very large, or a few relatively large, settlements in each; 3) within each cluster, sites occur in loci that suggest different productive activities; and 4) larger sites, taken alone, are more evenly dispersed than the aggregate of sites.

Johnson's focus is on the period between AD 950 and 1100. His research suggests that the coordination of specialized productive activities through central places was present in the area by at least this time.

Hirvela (1971) tested a number of hypotheses concerning the relationship between settlement shape and potential independent variables including the size of the site, the distance to usable raw materials, and the physical setting. Testing of the hypotheses proved difficult and most tests were negative. However, the best correlations that she found were between the shape of the settlement and the presence of 25 or more rooms. In other words, large sites are not simply larger than small ones but generally differ in respect to the formality of the pattern of the settlement. This evidence suggests that the labor expended in the construction of the site is likely to have been both greater and more formally organized than at smaller sites.

Coe (1972) considered a number of possible relationships between environmental stress (as defined by Hevly 1974) and changes in material culture. Her analysis suffers from small sample size (four sites) and a rather tortuous argument that two of the sites, which were contemporaneously occupied during a stress period, are separable into stress and non-stress categories since one is near what is now a permanent stream. Nevertheless, the effort did show some interesting relationships between site size and the presence of ornamentation and indicated significant variation in the overall density of artifacts between the sites.

Gregory (1975) described the excavation of six one-room structures in Hay Hollow Valley. The effort was intended to provide some evidence of the function of these sites in the settlement system. However, recovered artifactual materials were too limited to provide any firm basis for inferences. Nevertheless, primarily on the basis of their small size, Gregory

Figure 44. A pithouse is exposed by erosion in the wall of an arroyo near Nuvaqueotaka.

Figure 45. Homolovi II seen from the air.

Figure 46. Ruins of a field house near Nuvaqueotaka.

Figure 47. Chevelon site 690, a Pueblo site.

Figure 48. Chevelon site 689, a pueblo site with exposed walls but no mounding.

suggested that they were a functionally specific class of sites. He noted the importance of understanding such sites for the interpretation of settlement patterns in the area. For example, a calculated nearest neighbor statistic of 1.14 for the period AD 1000 to 1100 increased to 1.81 if the apparent field house sites are omitted. Thus, the apparent randomness of settlement patterning in much of the overview unit may be the product of the relatively casual decisionmaking involved in locating such small sites. This can mask a very regular and highly dispersed pattern for the major dwelling sites.

McAllister and Plog (1978) attempted to identify criteria that would clearly distinguish between small "field house" sites and larger dwelling units in the Chevelon drainage. Variations were investigated in the presence of different types of chipped stone, ceramic, and ground stone artifacts on sites of different sizes and different time periods. Analysis of variance and discriminant function analysis were the major statistical techniques used. Their analyses failed to identify any clear cut evidence that the range of activities carried out on sites of different sizes varied. The claim that small sites were functionally different from large ones was not supported.

Wood (1978a) proposed a site typology on the basis of his study of the layout of sites in the Springerville area. His approach is essentially intuitive. Nevertheless, the study illustrates the substantial variation in the presence of rooms, kivas, plazas, and their layout on sites that can occur within a very small spatial area.

Dove (1979) has analyzed ceramics obtained from three-wall, as opposed to four-wall, sites in the Chevelon drainage. His analysis suggests that corrugated ceramics are more typical of the latter than the former. This pattern may be a temporal one, since corrugated wares are later than plainwares. However, immediately to the west of the study area, plainwares are characteristic at all time periods. Thus, the four-wall sites may reflect some interaction or cultural affiliation with corrugated ware producing groups to the south or to the east.

Preliminary analyses also suggest that there is some organizational significance in the presence of one or more rooms with four full standing walls in areas where the typical pattern is one of three foundation walls. In the Chevelon drainage, (Plog n.d.), black-on-red and polychrome ceramics have a statistically significant association with such sites ($x = 19.49$, $p = .001$). Similarly, over 80% of the examples of exotic materials (such as shell, steatite, and turquoise) occur on such sites. Great kivas and larger three-wall sites were apparently functional equivalents as distinctive ceramics and exotic materials are also characteristics of these sites. Nevertheless, why the presence of four standing walls should result in so distinctive a pattern is unclear. Some central role in local settlement systems, probably related to exchange, is strongly suggested.

A number of additional studies are pertinent to differentiating sites of different types, specifically those that deal with ceramic and lithic variation. These were discussed in an earlier chapter and will not be repeated here. Ceramic variation seems to provide a valuable tool for identifying the role of different sites in local and regional settlement patterns. The value of chipped stone studies is less clear. Surface collections do not seem to yield interpretable results with any regularity for issues other than the differential use of raw materials.

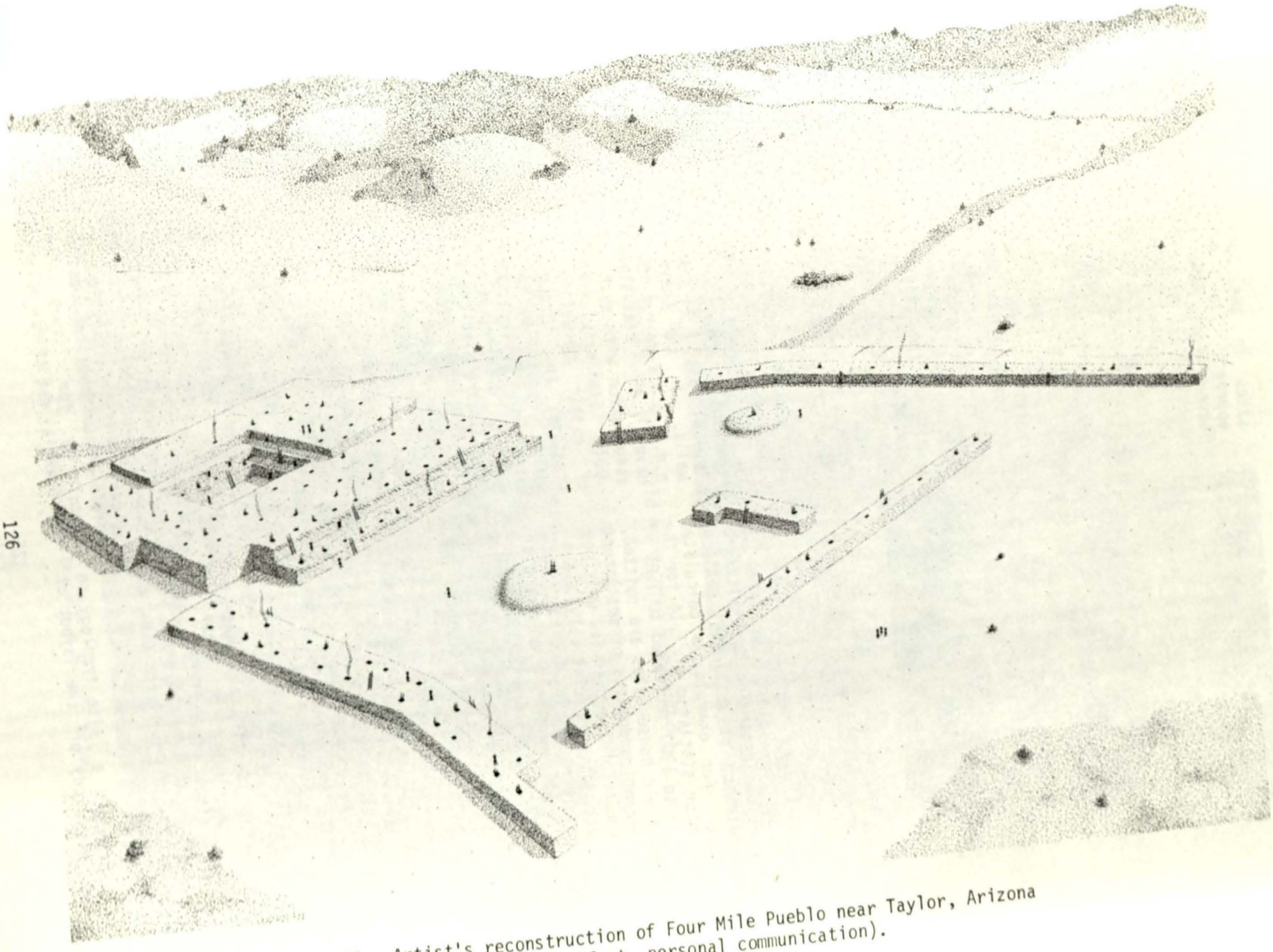


Figure 49. Artist's reconstruction of Four Mile Pueblo near Taylor, Arizona (Fewkes 1904; Lightfoot, personal communication).

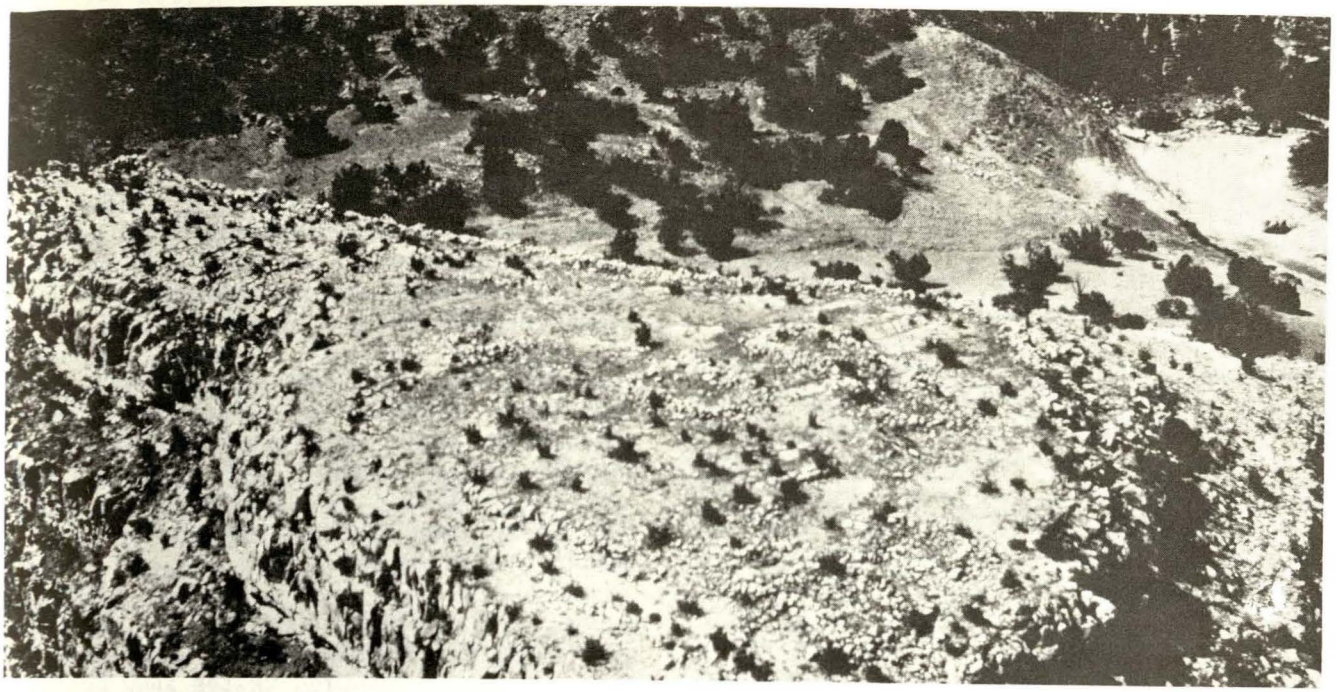


Figure 50. An aerial view of site CS-189, a defensive site in Chevelon Canyon.

Figure 51. Site CS-189 in Chevelon Canyon.

## SITES AND THEIR ENVIRONMENTS

A next set of studies has focused on locational patterning, the relationships of sites to one another and to various natural environmental features. Because many studies include analyses of both types, they are considered together.

Plog (1968) undertook a spatial analysis of the Longacre-Rinaldo survey data from of the Upper Little Colorado area. The analysis includes a reconstruction of population trends, changes in the distribution of sites, and changes in their location in respect to water sources and landform.

Bargen (1968) evaluated locational patterns in Hay Hollow Valley by comparing expected and actual distributions of sites. The valley was first divided into a series of roughly .5 miles by .5 miles squares. Each of these was evaluated on the basis of soil quality, availability of water, topography and erosion. A Monte Carlo simulation of potential population movement between the different squares was then undertaken.

He found that the actual distribution of sites corresponded fairly closely to the distribution postulated on the basis of the environmental ranking when evaluated using both chi square and rank correlation: the squares with the most desirable environmental conditions had the most sites. With the Monte Carlo simulation added, the correspondence between the actual and expected distributions were less close, although the rank correlation value remained significant.

Schiffer (1968) investigated the relationship between economic diversity and population growth in Hay Hollow Valley. The paper is useful principally for the manner in which it illustrates a number of different ways of generating population curves from the same data. It also illustrates means of testing to determine if some of the apparent variation in such a curve may be due to cultural or natural transformation processes that effect the

surface record. Vanasse (1968) and Duncan (1968) generalize some of Schiffer's results to other parts of Hay Hollow Valley and the Upper Little Colorado area generally.

Derousseau (1969) analyzed the pattern of site distributions in Hay Hollow Valley from about AD 600 to 1100. She was able to demonstrate an increase in the extent of clustering of settlements.

McCutcheon (1969) investigated the relationship between changing climatic patterns and the locations of sites in relation to water sources in Hay Hollow Valley. Dendroclimatological data were used for the climatic reconstruction. Her definition of distance to water source attempts to exclude channels that are a product of recent arroyo cutting and to include the locations of potential, if not currently flowing, springs. The results suggest no predictable pattern of change in site locations relative to water sources as the climate of the area changes.

Powers (1970) analyzed settlement patterning in Hay Hollow Valley using Theissen polygons. Her analysis focused on the period between AD 1000 and 1100. Performed for all sites, the analysis yielded complex results. There was no clear relationship between the population estimate for the site and the amount of land surrounding it. As a result, she postulated the existence of large central sites with multiple site communities surrounding them. This analysis was successful: there was a good correlation between the size of the polygon and its estimated population. Her analysis, then, suggests the existence of multisite communities in the area by at least AD 1000.

Sandor (1974) generated a series of cross-tabulations of locational and cultural attributes of sites in the Chevelon Drainage. Perhaps the most important pattern that he detected concerns the contrast between earlier and later sites. While the former occur in far more diverse environmental settings (especially in respect to elevation and vegetation), the latter are more diverse in respect to their cultural characteristics. Sandor does note that many of the earlier sites are larger than typical later ones, although the period when sites in general, and habitation sites in particular, are smallest occurs in the middle of the sequence.

Findlow (1974) used multivariate statistical techniques to summarize the locational characteristics of sites in the Chevelon drainage generally and in the Purcell-Larson locality specifically. Measures of slope, vegetation, and distance to water were employed in the analysis. Since the sites were the "cases" used in the analysis, the results do not take into account the environmental characteristics of locations in which sites are not found.

Nevertheless, Findlow identified nine locational types and used SYMAP to illustrate their distribution within the Purcell-Larson area. He provides some comments, based on ethnographic data, concerning the probable interpretation of the locational types.

Loria (1975a, 1975b) attempted to evaluate the relationship between site densities and environmental variables in the Show Low and Pinedale areas. Her analysis focused on vegetation, altitude, precipitation, and soil. The first three variables are highly correlated and the extent of overlap between them is not evaluated in the study. The areas in which sites are most likely to be found are characterized by ponderosa pine or a mixed ponderosa, juniper, pinyon pattern; elevation of 6600 to 6800 feet; 15 to 18 inches of precipitation per year; and gravel loam soils.

F. Plog (1975a) compared the settlement patterns of the Hay Hollow and Purcell-Larson areas. The article attempted to identify a number of key indicators that could be used in such comparative studies. Some major differences in the nature of settlement patterns of the two areas are identified: at most time periods, sites in Hay Hollow Valley were larger and denser. Population in Hay Hollow Valley was subject to more rapid increases and decreases (see also F. Plog 1975b). There were also many more sites without structures in Hay Hollow Valley than in Purcell-Larson. Tentative explanations were offered for the differences between the settlement patterns in the two areas.

Plog (1978) described the relationship between site locations and environmental variables in the Chevelon drainage. While a number of different potential environmental predictors are significantly associated with the presence of sites, the overall percentage of the variance accounted for by the model is not great.

Vegetation is the best overall predictor of site locations, with the greatest number occurring in the juniper pinyon woodland. A number of different statistical techniques are used in the analysis with varying results.

Jewett (1978) undertook a detailed study of spatial patterning in the Pinedale area using transect data and compared these with the results of block survey data. Her analysis showed a strong association between site distributions and ecotonal conditions. Variation in site size and site hierarchies through time are also demonstrated. This study probably represents the most detailed application of a variety of locational techniques to a single locality and illustrates the problems that arise from, and the advantages of, such as approach.

Hantman and Jewett (1978) compared the settlement patterns of the Purcell-Larson, Pinedale, Little Colorado Planning Unit and Hay Hollow areas. Their results indicated that substantial variation is characteristic of the area. Site densities vary from a high of 50 per square mile in Hay Hollow Valley to a low of 12 near Springerville. Hay Hollow has the most average rooms per site (12.8) while Springerville and the Purcell-Larson areas are least (2.3 and 2.5 respectively). The percentage of sites that are limited activity sites, or at least lack structures, varies from highs of 74% in Pinedale and 73% in Hay Hollow to a low of 34% in Purcell-Larson. Morill's index of continuity was used as a measure of site spacing and varied from a value of .5 indicating clustering in the Purcell-Larson area to a high of 1.35 in Pinedale, indicating dispersion.

Wood (1978a, 1978b) generated a predictive model of site locations for the Little Colorado Planning Unit. His data show that vegetation community and soils provide good indicators of relative site densities, with landform also an important factor.

Grove (1978) has used a number of different locational techniques in attempting to understand settlement patterning in the Bagnal Hollow locality. She used SYMAP in an effort to determine whether sites of different types were associated with landforms of different elevations. While the results of the study were mixed, they do suggest some differences between pithouses and pueblos.

In addition, there appear to be two very different and, perhaps functionally specific, classes of artifact scatters which occur at different elevations. A rank size analysis of sites in the drainage is convex, suggesting a multiplicity of small, independent systems. A variety of different spatial statistics failed to indicate any significant departure from random in the distribution of sites.

Adams (1978) has summarized a number of locational characteristics of sites in the Purcell-Larson area. Both site density and site size increased regularly, but not drastically, through the sequence of occupation. The average number of rooms per site was never greater than 3.0. Rank-size distributions are generally convex to plano-convex, suggesting multiple small systems within the locality. The major exception is between AD 1050 and 1125 when the distribution suggests a more hierarchical system.

Legard (1978a) calculated nearest neighbor statistics for the Chevelon Juniper Push, Pinedale, and Purcell-Larson areas. While she noted variation through time and through space, none of the statistics proved to be significantly different from random. Extrapolating these results to previous studies that did not evaluate the significance of the statistic, one must suspect that most, if not all, of the apparent variation in the nearest neighbor statistic over space and over time is just that.

Slawson (1978a) has used a number of locational techniques in describing settlement patterns in the Pinedale area. Like several other investigators, her analysis suggests that structural sites had a very different and much more dispersed pattern than all sites and than non-structural sites alone. She argued that the larger sites discovered in timber sales in the area are secondary centers to Pinedale and that these secondary sites, but not Pinedale Ruin itself, are surrounded by a zone of smaller habitations and then by a zone of limited activity sites. All of the nearest neighbor statistics on which she based her inferences did prove significantly different from random.

Legard (1978b) attempted to differentiate pithouse, pueblo, and limited activity sites on the basis of five environmental variables: landform, elevation, facing,

orientation, and distance to nearest water. Using discriminant function analysis, she was unable to detect any significant differences between these types. She also determined that the rank-size relationship for the area was convex, suggesting multiple independent centers (although it is far less so than that for some of the other areas discussed).

Millett (1981) undertook a number of studies of spatial patterning in Hay Hollow Valley between AD 850 and 1300. Nearest neighbor and various indexes of aggregation/agglomeration are discussed in relation to the postulated evidence of stress during the latter part of this period. Included are SYMAPs of both room and site distributions during the period in question that suggest the existence of settlement clusters, perhaps multi-site communities within the valley.

Blank (1979) has summarized a number of different aspects of our current understanding of site distributions in the Pinedale area. She noted that there is little evidence of a hierarchical settlement pattern defined using rank-size criteria. However, Blank also noted that the largest sites in the area were farther from one another than are smaller sites. She discussed the difficulties in achieving precise population estimates in an area where it is evident that even relatively large room blocks are sometimes buried.

Preliminary evidence from the area suggests that low density artifact scatters in the area are typically associated with only one or two periods of occupation. The greatest number of low density artifact scatters are associated with periods of rapid population growth at about AD 1000 and 1250. The first epoch is associated with the colonization of the area, and the second with the single most rapid period of population increase. Factors that affect the distribution of sites over the area were also considered.

Lightfoot (1978b) has argued persuasively for the existence of multi-site communities in the vicinity of Pinedale. His report summarized earlier thoughts concerning the existence of such an organizational and settlement pattern in the area. He also covered some of the pertinent ethnographic information and ceramic correlates to such a possibility. His basic approach was to use univariate and multivariate statistics to control for variation in time and in vessel function so that the remaining variation could be considered largely in regard to spatial boundaries. He was able to identify different clusters of sites in the study area in two of the four time periods under study. Of particular importance are two clusters, multi-site communities, that existed during the penultimate phase of occupation. The two are distributed parallel to one another in such a fashion that ecological and climatic differences between sites within each community are maximized.

Lightfoot was able to demonstrate that each community had one larger settlement with a kiva and that there are statistically significant differences in the ceramic design traditions associated with the two communities. While the paper utilized a more limited data base than would be desirable, it provides an excellent model for efforts to identify inter-community interaction while controlling for other variables.

In a subsequent paper, Lightfoot (1979) expanded on the theoretical and empirical reasons why multi-site communities might be present in an area with environmental diversity similar to that which is known for the study area. He argued for the presence of at least a one-tier system of managerial elite, and explored pertinent evidence. Lightfoot (1979) has also summarized the evidence of parallel problems and responses among Mormon communities in the area.

F. Plog's (1981) analysis of environmental patterning on the Apache-Sitgreaves National Forests is the most comprehensive effort to build a predictive model undertaken in the area to date. While the analysis may not be appropriate for lower elevations in the overview unit, since these elevations are not present in any quantity on the forests, it does indicate that elevation is the best site predictor at high altitudes with the vast majority of sites (88%) occurring below 7000 feet. Other variables improve predictability only slightly. There is a strong suggestion that, were more detailed soil maps available, soils would greatly improve the prediction.

## FUTURE RESEARCH: SITE TYPES

The distribution of great kivas is only roughly known at present. We need some understanding of the locales within the overview unit where these commonly occur in association with sites and those in which they are more typically found in isolation.

To understand the importance of redistribution in the area, variation in the ratio of storage to habitation rooms must be understood. We should also study the possible association of kivas and great kivas with sites with larger than expected numbers of storage rooms, must be understood.

The nature of major distinctions among sites without architecture (time, organization, or function) is almost completely unknown at present. On Black Mesa, most such sites, when excavated, have proven to have structures (S. Plog 1978). If this same pattern exists in the study area, a major component of the settlement pattern is being missed at present.

Pithouses use apparently persists on sites almost until the abandonment of the overview unit, either alone or with pueblo structures. Whether these represent functionally different sites, or ones with ethnically distinct inhabitants, is unclear at present. Again, it is unlikely that the prehistory of the overview unit can be understood without clarification of this issue.

While criteria for distinguishing defensive sites from other sites have been identified, these do not satisfactorily resolve the question of the nature of such sites. Whether they date to particular time horizons must be known if we are to understand the occurrence of conflict in the overview unit. Similarly, whether they are homologs of non-defensive sites in all criteria save locations, or whether they represent distinctive functional or organizational components of the settlement pattern, is not known.

## FUTURE RESEARCH: LOCATIONAL PATTERNING

Our current understanding of locational patterning in the area is best discussed by separating environmental and organizational issues. The principal efforts to understand environmental patterning in the area have resulted from a combination of planning studies for the Forest Service and Southwestern Anthropological Research Group (SARG) oriented efforts. As such, these reflect a relatively mechanical effort to predict site locations. The success achieved has been considerable and it is apparent that elevation, vegetation, landform, and soils should be a beginning point for any effort to predict site locations elsewhere in the overview unit.

At the same time, these studies have offered little insight into the reasons for the relationships that were discovered. First, sites of different time periods have rarely been separated. Second, little work has been done at the multivariate level that attempts to separate the interaction effects of the different variables. Finally, since the studies have rarely been coupled with excavation data, determining precisely what resources have been exploited in particular locations has been problematical. Badly needed at present are: (a) efforts to obtain better samples of floral and faunal remains from sites in the area, and (b) efforts to develop more complete models of the likely behavior of agricultural and hunting/gathering populations in the area generally and in respect to different microenvironments within it.

Evidence of organizational patterning is somewhat more complete but still tantalizingly incomplete. It is now obvious that there is immense variation in the size, density, and distribution of sites at different times and in different places in the study area. What is not now obvious is how this diversity was articulated, if in fact there is any sense in which the region was integrated. That some regional integration existed is strongly suggested by the growing evidence.

When limited activity sites, including field houses, are removed from site distributions there is an indicated pattern of dispersed site clusters. This is true in most, if not all, areas that have been studied to date. The existence of these clusters is also suggested by the convex rank-size curves that have been obtained in most studies, curves that suggest small autonomous systems. Missing from most such analyses are the largest and potentially most central sites that exist within the study area. No block or sample survey done

to date has included one of these sites; their records result from the early and unsystematic surveys. It is entirely possible that if such sites were integrated into existing studies, a linear rank-size relationship would be indicated.

There is very little in the way of innovative analyses that is required for remedying the deficiency that exists at present. (Useful variables have been identified and shown to be operational.) The integration of more diverse data sets, especially those including larger and more central places, with current studies should provide a substantial increase in our understanding of organizational patterning. (Of course, far more can be done as our understanding of the "elements" of the settlement pattern is refined.)

Inter-site variability in the study area remains, on balance, poorly understood. One can clearly go too far in attempting to distinguish between the functions of different sites in a settlement pattern. At present, however, the needed effort is only beginning. Through excavation, and, when possible, more detailed surface maps of sites, architectural and artifactual indicators of varied roles in a regional settlement system must be found. Of course, there is also still considerable need for studies that help to pinpoint the dates of the sites in question; separating dating from function (Figure 52) remains a major problem, as discussed earlier.

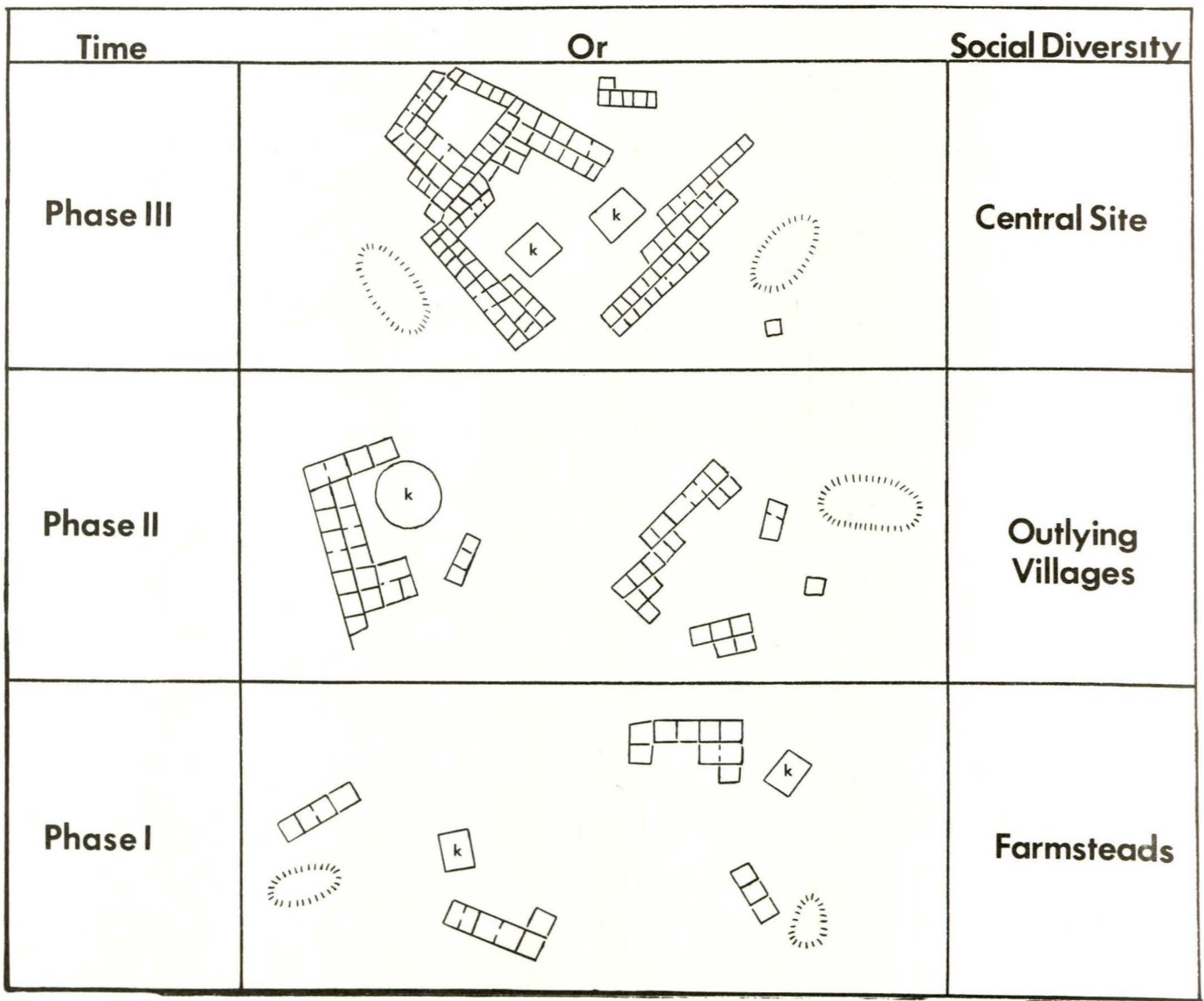



Figure 52. Differences in site size and layout could reflect temporal variation or a contemporaneous organizational pattern.

# ARCHEOLOGY OF THE LITTLE COLORADO REGION

## INTRODUCTION

The intellectual history of efforts to understand the systematics of regional prehistory for areas as large as that described in this overview is relatively brief. Summaries of regional prehistory have been common for decades, as have efforts to generate typologies of cultural patterning. But, it is only in the relatively recent past that archeologists have begun to explore methodologies for generalizing about large regions rather than assuming that such generalizations would readily grow from the results of excavation and more localized survey.

While I grant that there is room for disagreement, Willey's Viru Valley survey (1953) and Ruppé and Dittert's work in the Acoma Province (Ruppé 1966) represent the first characterizations of regional prehistory on the basis of field investigations specifically attuned to describing and explaining regional phenomena. Binford's discussions of research designs (1964, 1965) further elucidated the extent to which meaningful understanding of regional phenomena was unlikely to come from other than well focused regional research designs and field work.

The rapid growth in efforts to do regional archeology has been stimulated as much by the growth of contract archeology, especially the need for overviews such as this one, as by the growth of an intellectual tradition. The rapidity of that growth is perhaps best indicated by the existence of parallel regional literatures in archeology today, the citation patterns of each forming almost disjunct sets. For example, the regional analyses undertaken by members of SARG (Gumerman 1971; Euler and Gumerman 1978) draw little from the concepts and theories discussed by Johnson (1977) in his characterization of regional analyses and vice versa. Both of these differ markedly from Parson's (1975) summary of "settlement pattern" studies. While such provincialism is expectable in circumstances where a new research domain is being explored, there is much to be gained by exploring the manner in which efforts of different schools of regional archeology articulate.

Of equal importance is exploration of the manner in which strictly research oriented explorations of regions and management based studies can articulate. Surely, it is possible to distinguish between the concerns of managers and those of researchers. But, if management decisions are not informed by the best research strategies available, then it is unlikely that such decisions will be of the quality that we all desire. While it is easy to assume that managers and pure researchers want to understand different aspects of the prehistoric record, unless this assumption is documented, the true referent of the term "management information" is second rate data and inferences.

For these reasons, I attempt in the following pages to characterize regional archeology and its articulation with planning. First, I will consider the question of transformation processes and how these are to be understood at the regional level. Subsequently, the nature of inferences concerning spatial and temporal variation in regional phenomena are considered. Finally, I turn to the question of planning and how regional plans are informed by the approaches that have been defined.

## SITE FORMATION PROCESSES

A first set of theories necessary to interpreting regional prehistory concerns transformation processes. In a series of articles Schiffer has described the transformation processes that form, transform, and reform the archeological record at particular sites (Schiffer 1975, 1976, 1978; Schiffer and Rathje 1973; Reid, Schiffer and Neff 1975). There is no point in repeating the details of these discussions. My major concern is the extent to which attention to the site specific processes described by Schiffer will suffice for a consideration of regional archeology and the extent to which an inter-site focus and attendant field strategies require an elaboration of the work that Schiffer has done. Are there transformation processes that effect the regional record in ways other than their manifestation at specific sites? Does the fact that the regional record is known largely through surface collection generate problems in the understanding of transformation processes that shape the

record? The answer to both questions is "yes," and it necessitates a consideration of pertinent processes.

## NATURAL TRANSFORMATION PROCESSES

### Environmental Change

When site records are generated by survey, archeologists commonly make observations of the natural context in which the sites are found. Yet, because environmental change occurs, it is impossible to assume that the archeological context in which sites are found is identical to the systemic context in which they were utilized. At the same time, it is unreasonable to assume either that the archeological and systemic contexts differ or that the degree of difference is the same for all environmental variables.

While the archeological and systemic contexts of sites may be different, they are not necessarily so. In the early days of Southwestern pollen studies, many archeologists assumed that sharp contrasts between modern and at least some prehistoric conditions would be revealed. What is remarkable about the last decades' results is the limited evidence of change that has been documented. Certainly the environments of PaleoIndian and Archaic sites differed drastically from those of the present, as described in an earlier section. But, for later prehistoric sites, there is not evidence for drastic differences. That change occurred is clear; that the resulting environmental variation lies beyond the limits of modern variation is not.

Similarly, it would be a mistake to assume that the magnitude of change was the same for all relevant environmental variables. Precipitation and temperature conditions are the most likely to have changed. Vegetation patterns may or may not have changed. The character of drainages in an area is likely to have been similar at some points in the past and different at others. Major topographic features, in the absence of recent vulcanism, are relatively unlikely to have changed, although some topographic features, e.g., dunes, are more likely to have changed than others, e.g., basalt capped mesas. Certainly, a careful consideration is warranted of the probable magnitude of similarities and differences between modern environments and those that formed the systemic context of site systems at various points in the past. But, the analysis should never presume differences of great magnitude.

Our current understanding of prehistoric environmental variation in the study area was reviewed earlier. While appropriate data for understanding selected aspects of prehistoric environmental variation are available, they are woefully inadequate for meaningful regional generalizations in regard to the issues addressed above. These inadequacies stem from research with both prehistoric and modern focuses.

A primary problem in respect to modern records in the area is simply their limited extent. There are few weather recording stations relative to what would be desirable and even fewer detailed floral and faunal studies. The weaknesses of the modern baseline create immediate problems for generalizations concerning the prehistoric past. To the extent that planning activities carried out by Federal and State agencies generate more detailed environmental records, it is essential that these be made immediately available to archeologists working in the area.

Even with more complete modern records, there would be significant problems in prehistoric reconstructions. Pollen analyses are a case in point. The literature abounds with statements concerning the diversity of factors that affect the abundance of pollen of particular types recovered at a given locus (e.g., wind, humidity, and soil chemistry). But, as yet, no study has been undertaken that attempts to control for pertinent variables by analyzing samples collected from the modern surface (or appropriate pollen traps) on given days with known conditions. Until such studies are undertaken, the element of guesswork involved in the collection of prehistoric samples will remain so high as to render their results at least subject to substantial doubt.

Apart from this interpretive problem, there is the issue of the quantity and quality of specimens that it would be desirable to have from any given excavation locus. To the best of my knowledge, there is at present no study that investigates variation among samples taken from a single small living surface. While there is

certainly a perspective from which one can regard a 200 grain count on a single slide as 200 observations, it would be useful to know how much variation among slides exists. With this information, economy and efficiency in the collection of pollen samples could be balanced.

A final problem is the simple absence of an adequate data base from which generalizations might be made. Even in recent years, no pollen analyses have been undertaken from the majority of excavated sites in the area. Archeologists will be in a poor position to realize any of the potential of pollen analyses until such samples are routinely taken and analyzed. In this regard, the cost of anlysis is typically prohibitive. A regional center for pollen analysis that functions much as the Laboratory of Tree-Ring Research would clearly be desirable. At the same time, research designs generated by palynologists that sample the region in both cultural and noncultural prehistoric contexts is essential if our understanding of prehistoric environmental variation is to proceed at more than a snail-pace. The days when palynologists could afford to serve as the archeologists' handmaiden are long gone. Truly regional generalizations require regional research design and data collection, an effort that surely belongs in the hands of palynologists.

Control of tree-ring variation by dendroclimatologists is far more substantial and sophisticated than that of palynologists. The primary problem with our current ability to use this data base for regional generalizations is a dearth of recording stations. While it is again possible to envision modification of this situation through the gradual accumulation of data from archeological sites, an immediate effort to generate additional stations through a second "beam expedition" (the effort made in the 1930s to gather materials needed to complete the tree-ring plot) would greatly improve our control of climatic variation data in the area. As earlier discussions make obvious, the three recording stations now available in the area do not provide an adequate basis for regional generalizations. Again, research design and data collection specifically attuned to regional description and interpretation seem warranted.

Other analytical traditions are so poorly developed at present that one can only suggest the need for their initiation. Packrat nests have, to the best of my knowledge, never been studied in the inventory area. While some localities within the overview unit lack appropriate topography, much of it does not. Cliffs and talus, for example, bound most of the Upper Little Colorado drainage as well as the majority of its southern tributaries. Detailed analyses of paleosols are also absent in the area. Even routine flotation of deposits from archeological sites to obtain simple lists of available resources generally have not been done. Overall, there is a need for increased sensitivity to our currently poor understanding of environmental variation.

## Deposition

Deposition is likely to have a major impact on our understanding of the regional record in most areas. The existence of deposition is not the major source of the problem; even when it is heavy, sites can be located if appropriate survey techniques are employed. The problem is the differential effect of deposition, spatially, temporally, and functionally.

Temporally, the problem is straightforward: all other things equal, older sites are more likely to be buried than younger ones. Spatially, some topographic environments are characterized by higher rates of deposition than others. Deposition is more likely to have obscured elements of the archeological record in broad alluvial valleys than on flat mesa tops. Finally, there are functional problems: small and ephemeral loci, and those reflecting activities associated with depositionally active locations, are more likely to be obscured by deposition than larger and more permanent loci. Because prehistoric peoples carried out different activities in loci with different depositional conditions, it is necessary to consider the possibility that prehistoric activities associated with particular resource zones or time periods have been differentially obscured by deposition.

## Erosion

The role of erosion directly parallels that of deposition. Because they have been exposed to erosional agents for longer periods of time, older sites are more

likely to have been removed and redeposited than younger ones. Sites that were originally characterized by few materials are more likely to have been erased than larger ones. Sites in topographic environments that are erosionally active are more likely to have been removed than those in zones of less activity.

### Differential Erosion/Deposition

The interaction of erosion and deposition create a still more complex set of possibilities since one can imagine environments where one but not the other, both, or neither were active during the relevant time interval. The greater the complexity of the interaction between the two processes within a study area, the greater the probability that some elements of the archeological record have been preserved differentially.

An initial problem in interpreting the effects of erosion/deposition on the prehistoric record in the study area is, again, the dearth of modern data. Hydrological records are relatively rich. While they do not permit a detailed mapping of stream flow within the area, they are sufficient to indicate substantial variation. It is unlikely that the desirability of further studies for archeological purposes is sufficient to justify the expense involved.

Soil and geomorphological studies are another matter entirely. The available data are weak and inconsistent. The mapping of extent of erosion, for example, is scarcely more than what one could do by drawing isomorphs on the assumption that erosion is heaviest near major drainages and least in the uplands, with a gradient between. Regional sampling to more specifically identify erosional difficulties is likely to be generated in the course of land use studies. The immediate availability of such information to archeologists is highly desirable.

At the same time, archeologists' geomorphological expertise is generally weak and we have rarely requested funds for appropriate research at the level necessary to create localized understanding of cut and fill sequences. In this instance, localized studies are clearly warranted. The hydrological data alone are sufficient to suggest the improbability of identical sequences from drainage to drainage. The whole history of Quaternary and Archaic research in the area is a record of the destruction of what were presumed to be valid pan-regional sequences: most depositional and erosional events are present in some areas but not others and occur at different times and magnitudes even where they do occur (Ackerly, personal communication). When working with Federal and State agencies, it is appropriate for archeologists to request the necessary assistance from the agency in question. The need for developing appropriate expertise on nonagency funded projects seems clear.

### Catastrophes

While catastrophes should not be used to explain the evolution of prehistoric groups, the potential effects on the record of, for example, major floods or volcanic eruptions cannot be ignored. These are capable of obliterating evidence of prehistoric occupation over large areas.

Within the study area, the effects of three such phenomena require additional study. First, no meaningful research has been conducted in respect to vulcanism. It is generally understood that vulcanism may have been contemporaneous with the earliest occupation of the area, but the potential magnitude of this problem is not understood. Second, given the boom-bust pattern of stream flow in the area, the occasional prehistoric occurrence of floods that removed substantial portions of the archeological record in at least some drainages seems likely. Finally, and admittedly of somewhat minimal concern, is the possibility that high altitude glaciation obscured some aspects of the early prehistoric record in the region.

## CULTURAL TRANSFORMATION PROCESSES

### S-A Processes

Schiffer uses the concept "S-A process" to refer to those processes by which artifacts and sites move from a systemic to an archeological context: primary and secondary discard, abandonment, loss, and burial (Schiffer uses the term "disposal of the dead." I prefer the term "burial" since

objects other than human bodies, including whole sites, can be purposefully buried and since the dead can be disposed of by what amounts to discard). These same processes operate to form the regional archeological record. However, a major problem exists in regard to differences in their relative effects at different loci.

First, when the prehistory of a region is approached through surface collection and the generation of site records, it is extremely difficult even to identify the specific processes that led to the artifacts presence on the site surface. While S-A processes can be difficult to identify or control for when sites are excavated, there are at least some contextual bases for attempting their identification. But, materials removed from the site surface often lack such context. It is sometimes, but not always, possible to differentiate a deep midden from a thin surface scatter. While artifacts collected from within the boundaries of a room were not necessarily used in that room, they may have been used there. While a thin scatter of artifacts on a depositionally and erosionally stable surface may represent sheet trash, they may also approximate the distribution of materials left by the inhabitants of a camp site closely enough to allow behavioral inferences (see Wait 1976). If collections made from some sites are largely from areas of primary refuse, and closely reflect a discrete set of activities carried out there, while collections made at another site are largely from areas where it is common to find secondary refuse which reflects no particular set of activities, the potential for making incorrect inferences concerning the activities carried out at the two sites is very great.

Such problems become even more extreme when both relatively discrete, high density artifact scatters and amorphous, low density scatters exist within a single study area, or when low density scatters are the only observable cultural loci. In the first instance, the relation of the latter to the former is extremely problematical since the latter could represent the movement of artifacts from high density sites by natural or cultural processes. It also could represent a discrete activity pattern. On the basis of surface evidence, resolution of this issue is close to impossible.

In the second case, the nature of the S-A processes that formed the site are even more difficult to infer than with data from high density sites since the context of the materials is even less clear. While a greater than expected occurrence of artifacts in some specific plant community, for example, could be produced by primary discard and indicate extensive use of that community, it could also reflect the centrality of the community alone--more people walked through it more times during a particular annual round and lost or discarded more artifacts. This problem has not been adequately addressed by proponents of "non-site" archeology.

A final problem involving S-A processes is burial. Simply put, aspects of the archeological record generated by purposeful burial are extremely unlikely to be known on the basis of surface survey or surface collection.

Several lines of investigation would greatly improve our understanding of the effects of these processes on the archeological record. First, there is a significant need for investigations of the relationship between surface and subsurface deposits. None exists at present. This problem is ultimately a relatively easy one to resolve. Presumably, most modern excavations in the area distinguish between surface and subsurface deposits. Thus, it is likely that existing records from a variety of sites in the area would be sufficient for highly detailed analyses of surface-subsurface relations if sufficient funds were available for such a study.

Second, there is a very great need for studies of the accuracy and precision of alternate collecting techniques. Studies of survey techniques are now available and can serve as an excellent model for studies of collection techniques. Unfortunately, appropriate data are not currently available. In order to conduct the appropriate research, one would need a fairly large number of sites that have had 100% surface collections. A variety of different sampling strategies ranging from grab to statistical samples could be simulated using these data. Existing studies of survey strategies (cf. Stafford et al., 1978) have demonstrated that, given a sufficiently large sample size, great latitude can be exercised in designing

sample surveys. The applicability of their conclusions to collections from site surfaces could be quickly evaluated were the necessary site data obtained.

A third major problem concerns low density artifact scatters. For the reasons discussed above, the interpretation of these archeological manifestations is at best ambiguous. Moreover, they can present a major management problem. Collections and analyses of materials from a number of such scatters in different locations within the study area could quickly resolve the issue of their interpretability.

Finally, the entire set of issues concerning the processes that generate archeological sites is poorly understood within the study area. The only exception is the work of Schiffer and his associates in Hay Hollow Valley. His various writings provide excellent guidance for conducting studies of the effect of transformation processes in generating the patterns observable at particular sites. Those writings should be consulted for the design of appropriate research.

## A-S Processes

A-S processes are those that move artifacts from the archeological context to that of the modern system: collecting; pothunting; and excavation. Collecting and excavation are generally documented, although unpublished surveys and excavations do create problems. Pothunting and collecting by amateurs can have a major, capricious (Figure 53), elusive effect on the regional record.

Figure 53. In the Pinedale area, walls exposed in potholes are often the only evidence of Pueblo architecture.

Sites to which the public has easy access are more likely to have been effected by such activities than sites to which access is difficult. Large and obvious sites are more likely to have been impacted than smaller and more obscure ones. Finally, the kinds of artifacts that are removed from site surfaces may be quite specific. Metates and other large objects are more likely to have been removed from frequently visited sites than from low access sites. Decorated pottery and formally made tools, such as projectile points, are more likely to have been removed than undecorated pottery and debitage or casual tools. Thus, the kinds and frequencies of artifacts found at sites can be greatly affected by the differential removal of materials from them.

Very, very little is known of the impacts of such processes on the record of the area. I early noted that there is a distinct possibility that the impact of pothunting in the distant past was far more substantial than is evident from the inspection of site surfaces today. Two lines of research would greatly improve our understanding of this impact. First, it is desirable that an ethnography of pothunters be written as soon as possible. There are still individuals alive who observed, participated in, or at least heard of, the destruction that was occurring in the area at the turn of the century. These same individuals are a source of information on pothunting activities prior to the start of a major archeological presence in the area, which only began in 1960. These people should be able to provide at least rough information concerning the areas and sites where pothunting was the most intense. Admittedly, there will be difficulty in obtaining information from those who are still engaged in the activity. However, especially given the provisions of the Archaeological Resources Protection Act, Section 11, there should be relatively little difficulty in compiling a substantial body of information. This information could then be field checked to identify the presence or absence of modern indications of the activity. In addition, site records could be thoroughly reviewed and archeologists interviewed in an effort to identify the excavated evidence, reported or unreported, of the magnitude of disturbance.

A second line of investigation should focus on the modern effects of pothunting and collecting. A preliminary effort in this direction is reflected in the works of Lightfoot and Francis (Lightfoot and Francis 1978; Francis 1978; Lightfoot 1978). They attempted to determine the extent to which access via roads increases pothunting and the selective removal of particular artifact categories from sites. While their results are of a preliminary nature, the possibility of assigning degrees and zones of impact to particular modern activities that increase access or human activity in particular localities is clearly indicated. There is no reason why their analysis cannot be extended to include the full range of activities carried out by Federal and State agencies in the area. Plog (1981) has attempted to estimate the overall impacts of both land disturbance and pothunting on the Apache-Sitgreaves National Forests. Again, this information is critical for wise management planning and for understanding what components of regional prehistory are no longer available for investigation or have suffered qualitatively relative to others.

### A-A Processes

A-A processes are those that move cultural materials within the archeological context: later occupation; land-levelling; and channelization. Two major problems in interpreting the prehistoric record arise from the consideration of these processes. The first is later occupation. When sites are known principally through surface collections, earlier components may be variably obscured by later deposits. Also, it may be impossible to differentiate sites with lengthy occupations spans from sites with a large number of episodic occupations. The first problem is illustrated in recent work by Arizona State University at Chavez Pass Ruin. A number of previous investigators (e.g., Wilson 1969) argued for the sequential occupation of the three major room blocks at this site. Our own surface collections supported these earlier conclusions. Once test excavations were undertaken, however, a quite different pattern was apparent. The occupations of the three room blocks were late and largely contemporaneous. The three areas differed in the extent of earlier occupation and/or the extent to which earlier deposits were buried by later ones.

The second problem is equally evident if characterized in the context of seriation analysis. The relative percentages of materials from different time periods are likely to be the same whether a site was occupied throughout each of a series of time periods or only for short episodes during each. There is the further problem of early and late episodic occupations being obscured by lengthy occupation during some intervening period.

Levelling the land and channelization have regional impacts since these activities are non-randomly distributed in relation to environmental variables that may have been important to prehistoric peoples. Juniper pushing, for example, can easily obliterate much of the archeological record in a woodland while leaving that in nearby grasslands and pine parklands intact. Similarly, channelization is most likely to have occurred and destroyed sites in the vicinity of major drainages. Thus, select elements of the regional record can be removed while others are left intact.

Archeological studies of these impacts are, again, few in number. Major impacts that may be envisioned in the overview unit and elements of these that require further discussion follow.

### General Impacts

There is no question that the greatest single source of potential impact on cultural resources is a simple lack of awareness of those resources. While there is no way of documenting this argument, one must seriously question whether specific land modifying activities have had as much impact on cultural resources as that created by failure to be aware of the need to protect them. The casual destruction of sites and the casual removal of artifacts from site surfaces by agency personnel, contractors, and the general public may have had a greater effect on the quality of existing resources than the aggregate of land modification activities that have occurred there. Having raised this particular issue as a general one, it will not be addressed in the succeeding section. Means of increasing employee, contractor,

and public awareness are discussed in a later section.

## Timber Harvest Impacts

The greatest impact arising from timber harvesting is a result of the timber harvest itself. The movement of heavy equipment across the ground surface and the skidding of trees are the major direct impact. The construction of haul roads and landings is a second source of impact. These impacts occur to cultural resources, both those with and without surface manifestations.

The first impact is best resolved by prior survey of the area that is to be harvested and flagging cultural resource locations so that the movement of equipment through them can be avoided. As currently practiced, this approach has two negative side effects. First, it advertises the location of cultural resources to anyone passing through the area. Second, the flagging is frequently done so far in advance of the sale that many of the boundary markers have disappeared prior to the harvest. Technological means for resolving this problem potentially exist in the form of alternative site markers. Stores and libraries are beginning to use small chips placed in merchandise or books that amplify a transmitter signal. The use of such chips embedded in a site tag or a nail could be used to mark a site. The time required to return to a site and flag its boundaries immediately prior to harvesting in the area would be greatly reduced. Similarly, the flagging should be removed immediately after completion of the sale, with the tag remaining as a permanent indicator of the presence of a cultural resource.

The second impact is best resolved by actually surveying road and landing locations and realigning them, if necessary, to avoid sites. In this fashion, the costs and problems raised by conspicuous flagging can be avoided.

Given the energy crisis that we are currently experiencing, the cutting of fuelwood is likely to become far more of a problem than it has been in the past. Fuelwood cutting involves the movement of vehicles and trailers through an area. In addition, it increases the level of human activity in what have been relatively isolated areas. The potential for substantial additional impacts is great. At issue is the relative advisability of flagging sites to warn vehicle operators to avoid them (thereby drawing more attention to them) as opposed to simply ensuring that fuelwood cutters are aware of the potential existence of such sites and leave them alone when they are encountered.

## Range Management Impacts

Three activities of range management potentially impact cultural resources: juniper clearance; fence construction; and the construction of stock tanks. The first of these impacts is potentially the most damaging. The movement of heavy equipment through an area and the disruption of subsurface deposits when large trees are removed are the sources of destruction. These impacts have been largely avoided in recent clearance activities by prior survey and flagging of cultural resources. While there is potential for the same problems with flagging that arise in timber harvesting, the time lag between the cultural resouces survey and the clearance can be greatly reduced. Again, the flagging should be removed after the activity has been completed.

An indirect impact of juniper clearance is that it increases the visibility of cultural resources. A few early efforts to protect cultural resources resulted in tree zones around them that virtually identified the existence of the resource. Vegetative screens are left to minimize the impact of clearance on the aesthetic qualities of an area as well as its quality as a wildlife habitat. Incorporating the cultural resources into these will also serve to protect the cultural resources there. Such devices would be useful for providing an inconspicuous indicator of site locations in any circumstance.

Fencing has both direct and indirect potential impacts. Survey in advance of actual construction is probably not warranted since the actual zone of disturbance is not great. However, at least one individual able to identify cultural resources should be a member of the construction crew. An indirect impact of fencing is the use of fences as a trail through the forest. To the extent that hunters and hikers use the fencelines they will be attracted to nearby archeological sites and casual collecting may result. Thus, when a fenceline is

moved around a cultural resource it should be moved a sufficient distance so that the resource in question is not visible from the fenceline.

Because stock tanks are isolated points, minimizing their impact is relatively simple. As long as the site, and the means by which heavy equipment will be moved to the site, are inspected, direct impacts are easily avoided. The indirect impact resulting from the construction of a stock tank is the concentration of cattle in its vicinity. Site surfaces can be disturbed to a point where materials can no longer be analyzed when those surfaces are repeatedly trampled by livestock. Therefore, stock tanks should generally: (a) not be located in zones of exceptionally high site density; and (b) not be located in the immediate vicinity of an archeological site.

From these activities, a major secondary impact is derived--grazing by cattle. Evaluating the specific effects of grazing is only possible through specific studies of sites that have been impacted. On the one hand, it is clear that there can be impacts. The author participated in the excavation of one site that had been a stock pen. The sherds there were often so small as to defy analysis. But, this site represents an extreme situation.

Trampling along fence lines and in the vicinity of stock tanks have, to the best of my knowledge, never been evaluated. And a heavy degree of impact in these areas should not be assumed. Similarly, while it is clear that overgrazing can lead to erosion that in turn impacts cultural resouces, the magnitude of this problem has never been determined and remains a subject of great controversy.

## Engineering Projects Impacts

Apart from their role in the activities just discussed, the major impact of engineering projects is the construction of roads. The direct impact of road construction is the disturbance of the ground surface. Careful survey of proposed roads prior to construction is, therefore, warranted. To the maximum extent feasible, actual flagging of sites should be avoided for the reasons discussed earlier. The major impact of roads is opening public access to areas where cultural resources are dense. The major impact that enhanced access has had on cultural resources is discussed elsewhere in the report. Roads are necessary and some of these impacts are unavoidable, but they can be ameliorated by: (1) avoiding road construction in areas of exceptionally high site density; and (2) either leaving vegetation that screens cultural resources or revegetating in a manner that screens the resource from traffic moving on the road.

## Fire Suppression Impacts

The potential impact of fire suppression on cultural resources is substantial. Stories of fire crew members removing artifacts from sites and direct evidence of the destruction of cultural resources abound in the case of the Day Burn, one recent fire that occurred in an area of high cultural resouce density. Whenever possible, it is advisable to have one or more archeologists present during fire suppression to reduce the impact of the activity on cultural resources as much as feasible given the more immediate and pressing concerns. It is especially important that the sensitivity of temporary summer personnel to cultural resources be increased to prevent both casual and major destruction of cultural resouces.

## Recreation and Land Exchange Impacts

The primary direct impact of recreational activities is the construction of camp sites. In general, these sites increase access to cultural resouces. The magnitude of the problem created by that access is difficult to estimate, but it may be substantial. Most of the rock shelters, for example, in the vicinity of the Chevelon Creek campground are virtually devoid of cultural materials as a result of illicit excavation. The limits of the impact area are essentially defined by the average distance that citizen-users range from the camp during their stay there and this datum is at present unknown. It should be assumed, however, that survey undertaken in conjunction with the development of a new camping area should not be restricted to the direct impacts of construction.

Land exchanges are another potential source of impact. Unfortunately, there is a high density of cultural resources in the

vicinity of rapidly growing communities. Clearly, the relationship between the forests and those communities will deteriorate unless some allowance for their growth is made. Given that growth may occur in virtually any direction, planning for this eventuality should begin soon. Specific proposals are made in the discussion of the inventory of the forest's resources.

### Mining Impacts

Mining is by far the most destructive single activity that threatens cultural resources. Given that most mineral raw materials are now becoming scarce, this activity is likely to increase; the rising cost of the raw material allows the exploitation of previously uneconomical sources and efforts to discover new sources using more expensive techniques. Both testing and actual mining can be highly destructive. The movement of heavy machinery to drill locations can destroy sites. Similarly, there are some testing procedures that result in heavy impacts to the land surface within several hundred meters of the drill site.

None of the processes discussed above are well understood. It is easy in envisioning a particular project, to imagine major impacts that later prove to be minimal and to fail to suspect major impacts. Similarly, corrective measures that initially seem desirable may in the long run draw attention to, and increase impacts on, sites. Only through careful documentation of efforts to avoid sites, and the subsequent occurrence or lack of impacts, will the necessary knowledge be obtained.

### S-S Processes

These processes are ones that move cultural materials within a systemic context: recycling, secondary use, lateral recycling, and conservation. The negative effect of such processes on the prehistoric record is potentially great and difficult to evaluate. In essence, the question raised is the extent to which the first pothunters were in fact later prehistoric occupants of particular regions.

The problem is perhaps most evident in the case of projectile points. In some areas, early and late manufacturing technologies have been identified (cf. Plog 1974). Yet, most late sites, even the very latest ones, typically have points made using the early technology. Whether this pattern reflects the survival of the earlier technology or the systematic removal and reuse of earlier points from earlier sites is impossible to say. The removal of building stones from earlier sites for use in the construction of later ones has also been discussed.

While such behavior almost certainly occurred, it is easy to confuse a settlement that had only foundation stones rather than full standing walls with one from which stone was removed. The ultimate extent of recycling and reuse at the regional level will be difficult to define. But, it certainly must be considered rather than simply assuming that the materials found at a particular loci were made by the people who lived there or by their contemporaries.

Clearly, one can become so concerned with the potential role of such processes in obscuring behavioral patterns that behavioral analyses no longer seems fruitful. It is not correct to argue, as some students of transformation processes seem to, that one cannot do archeology without controlling for these processes. At the same time, one should never fail to control for intervening variables whenever possible. There is little doubt that some of what we currently perceive to be patterns of material culture left by prehistoric peoples in the overview area will prove to be the products of transformation processes. The sooner archeologists are able to undertake studies such as those mentioned throughout the preceding discussion, the better our interpretations will become.

## DESCRIBING SPATIAL VARIATION

Assuming that transformation processes are controlled and described to a meaningful extent, the major focus of archeological analysis is the description, interpretation, and explanation of spatial and temporal patterns. Spatial patterns and their treatment are considered here and temporal patterns are considered in the following section. In both discussions, the need for truly regional approaches is presumed. That is, I do not assume that a genuine picture of regional patterns will emerge

from the accumulation of site excavations and local surveys. Instead, my assumption is that generalizations about large spatial entities require research designs specifically attuned to that task, research designs that involve a dynamic interplay of local and specifically regional analyses. Spatial variation in artifactual distribution, settlement systems, and behavioral systems are independent foci of the following discussion.

## Artifacts

There are two current problems that confound efforts to describe and explain artifactual distributions at the regional level: for some artifact classes our understanding is too limited and for others, too complex. Perhaps the best example of the first problem is stone technology. There is no typology for either chipped or ground stone that is shared by archeologists working either within the Southwest or within a particular region of it. Even efforts to establish terminological consistency between different classification systems are lacking.

At first glance, the problem of ever attaining the agreement necessary for such a lithic classification system seems insurmountable. It can, however, be easily overestimated. I would suggest that most of the lithic typologies that have been used presume that lithic technologies should ultimately attain the same degree of formality that is characteristic of ceramic systems. Recent studies challenge this assumption. In the cases of both chipped (Decker 1976) and ground (Mundie 1976) stone, statistical analyses of attributes have resulted in the definition of relatively few types. That is, of all the categories that archeologists have used in defining different types of scrapers and knives, few prove to have integrity when subjected to attribute analyses of a relatively large collection of artifacts. Certainly, the archeologists who created the earlier typologies recognized distinctive forms, but quantitative treatments show both a complex and a relatively continuous pattern of variation among the ideal types defined on the basis of especially distinctive forms.

The underlying problem seems to be that the behavior of prehistoric peoples, as they utilized chipped and ground stone tools, was far less structured than that involved in making and using ceramic vessels. What was originally a projectile point could be, and often was, refashioned as a knife or scraper. What began as a casually retouched piece of stone became a formal scraper through episodic use and retouch.

The possibilities are endless and existing evidence suggests that prehistoric peoples did not simply make and subsequently use stone tools. Instead, they used flakes eclectically in a process that involved many discrete episodes of manufacture, use, modification, and reuse in a sometimes exceedingly complex chain. Until more studies demonstrate what categories and/or attributes are useful in characterizing variation in lithic technology, it is unlikely that we will be able to understand the functional variation in activities that were undertaken at particular sites as they are reflected by variation in this class of artifacts. On the other hand, these same studies may identify a simple typology.

The movement of raw materials used in manufacturing stone tools is also poorly understood. When analyses have been undertaken (cf. Green 1975, 1978), considerable support has been generated for the proposition that some raw material classes were exchanged over a wide area. Unfortunately, there are so few such studies that the magnitude of exchange, not to mention the patterning of exchange relationships, is impossible to characterize.

Ceramics are an example of the problem of too complex classification. Simply put, archeologists have allowed themselves such latitude in defining types that it is now close to impossible to establish equivalencies within, not to mention across, regions. This situation is particularly unfortunate since a consistent application of the standards used by Colton in the early period of type definition would have resulted in a very different situation. His approach was directly modeled on the process of manufacturing a vessel. Technological distinctions were used to create wares, stylistic distinctions to create types within wares. Unfortunately, he and others, to a more substantial degree, began to use space-time rather than formal attributes in generating definitions.

We now face a situation in which, for example, the technological variation within the category "Cibola White Ware" can only be described as five different wares if the criteria that are used to separate Tusayan from Little Colorado White Wares are consistently used. Similarly, we have failed to resolve the question of whether a horizon style system, cross-cutting wares, can be defined for the northern Southwest. Wasley (1959) proposed such a system some years ago, but Breternitz's analysis of tree-ring associations appeared to contradict it (1966). (The reasons for using the term "appeared" will be discussed later.)

Dee Green (personal communication) observed some years ago that the temporal sequences of change in line width and line density on painted sherds was similar on the various National Forests within the Southwestern Region. As noted earlier, recent analyses of stylistic change within major domains (e.g., Kana'a-Black Mesa-Sosi; Puerco-Reserve-Tularosa), using materials from the Upper Little Colorado and Kayenta areas, document regular changes in line width that correspond roughly to the horizon styles defined by Wasley (Hantman and Lightfoot 1978; S. Plog and Hantman 1978; Hantman, et al., in press).

I suspect that there are indeed horizon styles with pan-regional integrity. I also suspect that we will gain much in our understanding of regional prehistory as we begin to see that there are, at virtually every time period, some areas of the northern Southwest that have a localized style rather than the one that then characterizes most of the area. In any case, regional prehistory will be far easier after the efficacy of a horizon style system has been resolved.

There is also a major unresolved issue in our understanding of ceramic exchange. Virtually every petrographic study of Southwestern ceramics has suggested relatively localized manufacture and relatively widespread exchange (see S. Plog 1977, 1980 for summaries). Even Colton's ware system monitors this variation relatively well. Coupled with the nearly absolute failure to find evidence of ceramic manufacture despite decades of excavation, the case for specialized production and widespread exchange, rather than village-level ceramic manufacture, is strong. Yet, existing literature continues to assume village-level manufacture. The implications for understanding regional prehistory are enormous. If the petrography is correct, an enormous volume of material items circulated in the study area in every calendar year.

For effective regional analysis, typological and distributional problems such as those described above must be overcome. Until they are, the interpretation of even our most basic artifactual evidence is in doubt. And, problems with artifactual interpretation create difficulties in virtually every other area of analysis. As noted earlier, it is impossible to discuss with any security the distribution of Pueblo I period sites when a clear argument associating this time period with a particular artifactual assemblage cannot be made.

I do not intend that any of the above be interpreted as a recommendation that monolithic typologies be created and that archeologists working in the overview unit all be forced to employ them. Nevertheless, some commonality in the manner in which artifacts are described is essential if the results of independent research efforts are ever to be comparable. The commonality that I envision would be sufficient to place artifactual materials with gross spatial and temporal units, at least allowing dating within a 100 year period and allowing at least initial confidence that particular artifacts were or were not made in a particular area. At the same time, an effort to generate such an approach would recognize that independent attributes of particular artifact classes vary for different reasons. The variation in some attributes is temporally sensitive, others spatially sensitive, and still others functional. Other detailed local analyses will tap the rich potential of such attribute analyses and it is dubious that sufficient detail can ever be contained in a workable regional scheme.

It is indicative of the current state of our understanding of these issues as they pertain to the overview unit that many of the citations used to illustrate specific points are studies undertaken within the area. A number of the distributional studies described in this document simply have no parallels at the present time elsewhere in the Southwest (the computer

mappings of ceramic and chipped stone raw material distributions, for example). Nevertheless, it is precisely these studies that have led to perception of the clear need for a greater investment in typological studies. These are important not simply for interpretation of the prehistory of the area, but because effective management cannot occur without standardized and comparable treatments of artifacts in spatially disparate contexts. Specific studies that need to be undertaken were identified in earlier chapters. Here the discussion has focused on how the further interpretation of the materials in question might proceed.

## Spatial Systems

One might argue that the logical next step in attempting to construct a regional approach is a consideration of sites and variation in site types. However, it seems, on the basis of recent literature, that the concept "site," is a highly problematical one, at both extremes. On the one hand, where one draws the boundary between sites and low density artifact scatters is an issue. In some parts of the Southwest, such low density scatters or "non-sites" are more typical than sites. On the other hand, not all sites are communities or even settlements. Multi-size communities have been described in a number of areas. Thus, I suggest that instead of building regions from sites, it is preferable to begin with an effort to understand the distribution of material remains irrespective of how those remains are agglomerated into entities that may be called sites. From this perspective, the major analytical effort is toward analyzing the pattern of the distribution of cultural points, (architectural or artifactual), however those points are defined.

Points can first be analyzed in respect to the environmental settings in which they occur. There are two pertinent methods for exploring this relationship. The first is site catchment analysis (Vita-Finzi and Higgs 1970). While this approach is useful in considering environmental relationships for a relatively few points, its application is somewhere between difficult and impossible when the number of sites under study is large. There would be large numbers of sites in the case of most, but certainly not all, regional studies. Nevertheless, it can be profitably applied to a sample.

The second approach is that developed by SARG (Gumerman 1971; Euler and Gumerman 1978). This more analytical approach seeks correlations with particular environmental variables. As recent descriptions of SARG efforts demonstrate, these variables can be treated in terms of local and regional patterns as well as individually. The ultimate goal of both site catchment analysis and the SARG approach is the same: to understand the manner in which prehistoric peoples used their environments and the manner in which the environment shaped their use of particular areas.

Locational or point pattern analyses of the relationship between a set of points have now been described in some detail and from a number of different perspectives (F. Plog 1974; Hodder and Orton 1976; Clarke 1977; Johnson 1977). Common to all of these approaches is the assumption that attention must be given to characteristics of a system of points rather than the unique characteristics of the points themselves, although the latter may very well be differentiated in a set of types or categories. Characteristics of the distribution are then measured: density, evenness, agglomeration, differentiation, integration, hierarchy, and symmetry. There are appropriate quantitative techniques for each. Each measure is implicitly systemic because the value or condition that a particular variable takes is a product of the relationships among the entire set of points. Properly used, such analyses define localities or subsystems within regions and identify their distinctive properties.

It is undeniably difficult to escape familiar paleoethnographic handles such as butchering camp, field house, town, etc., and the equally familiar notion of an ideographic version of the cultural landscape, a settlement pattern. Nevertheless, the time has come to recognize the dubious empirical content of such terms for many regional situations. Simply put, too many different usages of a given locus are possible to allow the conclusion that such analogic characterizations are providing real information. Similarly, eyeball analyses of distributional maps leave too much room for observer bias and error to permit confidence in their results. A more

structural approach, where structure is defined over largely quantitative elements of the points under analysis, is the more likely source of understanding of settlement and spatial systems.

The studies that will lead to further understanding in this area were discussed in earlier chapters on intra- and inter-site settlement patterns. Comments made here are primarily intended to clarify the broad implications of such efforts. While archeologists will never completely agree on acceptable site typologies nor on appropriate locational statistics, some agreement is essential if the cultural resources of the area are to be managed with any overall design in mind.

## Behavioral and Organizational Systems[1]

In 1968, and in reaction to the efforts of new archeologists to do paleoethnography, Marvin Harris warned against the use of familiar ethnographic terms in describing prehistoric behavior and organization. Whether at the inter-site level (tribes, bands, etc) or intra-site level (residence groups, etc.) such terms are highly problematical in the ethnological and ethnographic literature and likely to be more so in the past. More recently, Leaf (1973), Quinn (1975) and others have cogently argued that the social behavior and categories that have been described as rules, norms, and even groups are best treated as elements in complex decision structures, not real behavior.

Avoiding mishandling of archeological data requires changes both in the way in which we employ the theoretical literature of sociocultural anthropology in formulating interpretations and the way in which we employ ethnographic data. The major problem that typically arises in using the theoretical literature occurs when typologies are employed. Most archeological discussions of social organization, for example, are based on either Service's (1962) or Fried's (1967) typology.

The use of these typologies to interpret the prehistoric past necessarily involves four major problems. First, when some key attribute is used as a basis for classifying a particular site or region in terms of a typology, the nature of explanatory arguments that can be explored is either sharply truncated or becomes hopelessly circular. If, for example, the size of the largest settlement is used to define state organization, it is impossible to construct arguments relating state organization and population aggregation; such an argument would be tautological since population aggregation was used to define state organization.

The second and third problems stem from the typologies themselves, from the very fact that they are based on ideal types. As Fried has observed, the advantage of ideal types is that they isolate key aspects of variation and key patterns of covariation by treating complex continua as simpler categories. I do not doubt the importance of such simplification in the search for structural regularities. However, there are two difficulties created in the study of prehistory. On the one hand, when one studies evolution, it is precisely the complex patterns of continual variation that are crucial to understanding why the patterns identified by categories of ideal types are the most typical outcomes of evolutionary processes. One must be able to explore the range of variation to understand why there are relatively few typical outcomes. On the other hand, if we are to take seriously the claim that one strength of archeology is the ability to identify behavioral and organizational patterns not found in the ethnographic and ethnohistoric records, then we must employ conceptual strategies that allow the possibility of patterns of variation and covariation not found in the present. Thus, in both respects, a more continuous approach to the archeological record is desirable.

A fourth problem arises when summary categories are injudiciously used by archeologists, ethnographers, or both. I do not question the utility for some discussions, arguments, and syntheses of applying terms such as band and tribe, egalitarian and stratified. But, there are limits to the kinds of analyses in which the use of such terms is appropriate. Because these terms mask substantial variation in particular institutional, status, and power patterns,

1. The following discussion was prepared in collaboration with Steadman Upham.

their utility for detailed comparative and evolutionary studies is questionable. Perhaps more important is the danger of too quick a summary judgment and subsequent failure to reevaluate evidence of variation over space and time.

Virtually every typology of social forms presents similar problems. I have previously noted (Plog 1977) the difficulty in separating reciprocity, redistribution, and marketing on behavioral criteria alone, not to mention artifactual patterns. And, it is unlikely that most of the groups occupying the overview unit after about AD 300 were easily classifiable as hunter-gatherers or agriculturalists. The probability is quite high that the same cultural and biological group drastically shifted its subsistence procurement behavior over time. There is also the probability that nearby groups practiced different strategies.

A second problem arises when summary descriptions of behavior and organization are borrowed from the ethnographic literature. This has typically occurred in the case of the overview unit in the abuse of Puebloan ethnography.

For example, by virtually every summary classification, the modern Pueblo are tribal and egalitarian. As a result, analysts of Puebloan prehistory typically assume these patterns. Yet, there is more than suggestive evidence of very non-egalitarian organizations and behaviors among the Pueblo. Brandt (1976) has contrasted the "New" and "Old" People at Taos:

> These groups represent emergent social classes. The New People are poor ceremonially and tend to be poor in other respects as well. They are disenfranchised and lack kin support which would enable them to obtain favorable grazing permits and access to land. They are unable to hold political office and rarely have friends in high places . . . . The lulina (Old People) are leaders and produce leaders. They allocate land, water and permits (1976:11).

The Old People, who number 50 out of a population of 1200, hold all of the political and ceremonial offices in the Pueblo. Membership in the group is inherited patrilineally. A similar situation has been described at Acoma Pueblo where the Antelope Clan holds all political and ceremonial offices and is far wealthier than any other clan (Ruppé, personal communication). In point of fact, substantial variation in wealth and power between individuals and groups has been described for most Pueblos, not to mention craft specialists and "caciques." And, this information exists despite the consummate skill with which the Pueblo are able to shelter intra-village reality from the outside world (Brandt 1976).

Of course such evidence is generally dismissed as a product of Pueblo participation in modern economic and political systems. And yet, there are both ethnohistoric and prehistoric data suggesting that stratification and political complexity have existed for some time in the Pueblo area. For example, high status burials, elite residential complexes, craft specialization, and status restricted material goods have now been documented prehistorically. Similarly, the records of the entrada indicate that the chiefs of particular settlements were capable of assembling large quantities of goods. Espejo, for example, is said to have been given 4000 cotton mantas by the cacique of Awatobi (Hammond and Rey 1966). Even granting overestimation and misrepresentation by the Spanish recorder, the production and distribution of so sizeable a quantity of one craft good is inconsistent with the argument that the Pueblo were egalitarian.

The point of this discussion is not to argue that the Pueblo are, in fact, a stratified society. Rather, the claim is that there are elements of both egalitarian and quite highly stratified organizations and behaviors in Pueblo culture that have considerable time depth. At various times and places, particular Pueblo settlements were almost certainly characterized by quite complex political and social organization. Either our commitment to an Apollonian view of the Pueblo, or the necessity of identifying unbroken Puebloan traditions that grew out of the land claims cases, has interfered with anthropological judgment.

Perhaps it is also too heavy a reliance on summary categories that necessarily obscure some variation that has prevented us from seeing that evidence of complexity and stratification among the Pueblo cannot simply be dismissed as a product of white contact. Again, these same problems arise

when a "direct historical" argument is used as a basis for preferring Puebloan, or a particular subset of Puebloan, ethnography over alternatives. It is likely that only through employing the full range of southwestern ethnographic literature will we formulate interpretive models that are sufficient to describe the range of variation that actually occurred in prehistoric times.

Recognizing such problems, Cordell and I (1979) have recently argued that our most meaningful investment in attempting to describe the past will come from the study of strategies, coping behavior. Specifically, we have argued that demographic, productive, and organizational strategies are likely to be the best bases for understanding prehistoric organizational variability. In a regional context, such an approach begins with the assumption that the inhabitants of different sites and localities were, in all probability, involved in quite different strategies. To the extent that these strategies are harnessed in sub-regional or pan-regional systems, it is through interaction, alliance and exchange. Thus, if efforts to describe and explain artifactual and settlement distributions are to achieve fruition, it will not happen through the assumption of regional homogeneity. Rather, we require careful investigation of local similarities and differences and how they are integrated through casual interaction and/or hierarchically and non-hierarchically arranged alliance and exchange systems.

Such an effort must begin with more detailed discussions of variation in particular strategies across the overview unit. At present such a description is impossible, but suggestive data do exist. For example, the earlier discussion of demographic variation focused on two areas, Hay Hollow Valley and the Purcell-Larson locality, for which acceptable demographic studies have been done. It is clear that the demographic trajectories for these two areas were not the same. Whether different trajectories will be identified for other areas is unknown. Similarly, evidence of craft specialization in some sites was reviewed. How widespread and varied this phenomenon may be is also unknown. The stellar architectural diversity of the overview unit was described, although even a beginning interpretation of this diversity is missing at present. Given even these preliminary data, it is clear that there is potentially enormous variation over the overview unit in the particular demographic, productive and organizational strategies that were employed. Much careful analysis and description is necessary though, before we will be able to describe spatial variation in such strategies.

But, detailed local descriptions are ultimately unsatisfactory. The question of large organizational entities must ultimately be addressed: were there times when the overview unit, or most of it, functioned as a single interactive, or even political, entity? Answering such a question again involves the dynamic interplay of local and regional analyses.

At the local level, the analyses of interaction and multi-site communities discussed earlier is needed. These provide a means of working from the bottom up toward an understanding of larger interactive and organizational units. Point pattern analyses are also useful in that, applied to larger bodies of survey data, they may identify clusters and verify the reality of the apparently variable density that one may divine from existing records. Distributions of distinctive artifact types and styles provide a means of working from the top down.

I have argued elsewhere that the concept that most closely approximates the notion of region is what Ruppé and Dittert have called a "province." Provinces are defined by a distinctive system of material culture that is assumed to result from interaction. However, both behavioral and organizational variation are assumed to have occurred within the province. I find this concept appealing for both theoretical and empircal reasons. Theoretically, one ought to be able to define such spatial entities. Recent discussions of mate and material exchange (e.g., Sanders 1975; Wobst 1977; S. Plog 1977) suggest that, controlling for population densities, there are upper and lower limits to the expected spatial extent of interaction and exchange. Empirically, the size and shape of provinces, such as Zuni and Acoma, that have been described correspond to such expectations. They are roughly hexagonal and about 15,000 square kilometers in area. Similarly, even given the vague characterization of actual boundaries, maps showing the location of cultural branches appear to correspond with expectations for province locations and

boundaries, at least for the Anasazi area during the period AD 900 to 1400 (F. Plog 1980).

The strategy I envision for characterizing such provinces does not involve generating definitions of average or typical characteristics of one province for comparison with others. Rather, I would examine the way in which the province is built through interaction and exchange between local groups that were, in all probability, culturally and organizationally distinct. As Cordell and I (1979) have recently argued, a major source of our misunderstanding of the prehistory of the northern Southwest is a result of preoccupation with facile descriptions of what is typical at most times and places. Understanding organizational and evolutionary dynamics necessitates a concern with the manner in which local groups that were distinctive in their demographic, exploitative, organizational, and symbolic patterns came to be articulated into systems of diverse sorts. These systems are sometimes intra-regional, sometimes regional, and sometimes pan-regional.

Admittedly, we are not always in a position to begin a particular study with a well defined province. Naturally defined entities (a drainage, or a foothill zone) or one defined for managerial reasons are more typical starting points. Nevertheless, a crucial initial question is whether the entity contained single or multiple cultural entities at different points in time. Such descriptions are, however, ultimately of composition or behavior rather than of structure. Structural descriptions necessitate a more careful treatment of political organization, which itself proves a domain for archeological analyses.

Fried defines political organization as,

> . . . those portions of social organization that specifically relate to the individuals and groups that manage the affairs of public policy or seek to control the appointment or action of those individuals or groups (1967:20).

At a general level, Fried's definition is acceptable. For archeological purposes, the emphasis must be placed on evidence of the manner in which affairs were managed since access to information on specific managerial individuals and groups is difficult without written records. Thus, archeological data are not best analyzed in terms of the status and role related concepts of egalitarian, rank, and stratified societies that Fried has developed for ethnographic groups.

Although status and role are pertinent, the archeological record, to the extent that it reflects political organization, is the product of managerial decisions broadly conceived. In any society, the most basic such decisions concern: (1) access to space; (2) access to human and natural resources; (3) access to social statuses and organization; and (4) access to social symbols. Across societies, access in each of these areas varies in: (1) the extent to which it is restricted to particular individuals and/or groups; and (2) whether the restrictions are consensual or cooperative.

The extent to which one can demonstrate that particular patterns of decisionmaking are likely to leave clear patterns in material remains is critical to the success that archeologists are likely to achieve in studying political organization in the past. The difficulty of this task should not be underestimated. While it is beyond the scope of this essay to discuss all of the issues mentioned above, a consideration of variation in access to space will illustrate the problems that arise and approaches that might be taken.

In recent years, a large body of literature has appeared concerning human territoriality (see Plog and Upham, in press, for a summary). There is little agreement about territoriality in these studies, the vast majority of which, both archeological and ethnographic, deal with band level societies. As Dyson-Hudson and Smith (1978:21) point out, "The territoriality controversy in anthropology has primarily focused on hunter-gatherers." King (1975, 1976) and Peterson (1975) are recent examples of a long line of anthropologists (e.g., Radcliffe-Brown 1930; Service 1962; Williams 1974) who argue that some form of territorial band is the optimum pattern of spatial organization for hunter-gatherers under all or most ecological conditions. Various authors (e.g., Lee and DeVore 1968; Damas 1969) have argued that a more

flexible pattern of spatial organization and resource utilization is typical of hunter-gatherers.

Dyson-Hudson and Smith ultimately argue that both patterns are possible but will occur under different circumstances. Specifically, defense of an identified territory is likely to occur only when,

> critical resources are sufficiently abundant and predictable in space and time, so that costs of exclusive use and defense of an area are outweighed by the benefits gained from resource control (Ibid).

One can extend their analysis by noting its articulation with the common anthropological distinction between proprietary and usufruct rights. In essence, at any level of social organization (the family, village, clan, or cultural group) individuals and groups may seek to claim proprietary rights over space. Yet such a claim is neither necessary nor necessarily common, but only likely to arise in specific circumstances as described above.

This formulation is particularly useful for archeological purposes because it forces upon us a clear distinction between the observation that a particular group of people occupy space and the claim that they either define or defend an explicit territory. In all probability, the continuum between these two extremes, especially prior to the existence of state organized societies, was quite complex. It is difficult to believe that there was not a great deal of fluidity in the spatial domain that a given hunting-gathering band occupied. In all likelihood, that space changed regularly in response to the growth and decline of a group, similar processes operating in those around it, and short-term and long-term fluctuations in climatic patterns. This same variation would have produced changes in the extent to which territories were explicitly defended. At the other extreme are groups that defend territories and do so with complex political coordination and use specialists, soldiers. Many combinations are possible. Many specific organizational entities can assert proprietary rights over space: households within villages; villages; clans that are either within or cross-cut villages can all claim and defend rights to space. Similarly, there is no reason to assume a temporally invariant pattern for any given location.

Given this potential complexity, what evidence of the waxing and waning of territorial behavior can archeologists expect to discover?

## Distributions of Material Traits

It is tempting to view the spatial zones that can be defined on the basis of material trait distributions as indicators of territories. It is true that in at least some areas it is possible to define periods of time when the distribution of such traits is relatively homogeneous over a broad area and others when a number of highly distinctive divisions of that same space are warranted. Unfortunately, our growing understanding of the manner in which such boundaries are generated by interaction and exchange provides little support for the notion that such distributions reflect actual territories. Whether such zones were occupied by particular ethnic groups or whether they simply describe patterns of particularly intense interaction or exchange, there is no a priori basis for inferring that the spatial entity in question was consciously perceived as an exclusive territory, much less defined as such. I am not arguing that such distributions are irrelevant to the topic of this paper and will return to the issue later.

## Boundary Markers

Shrines, cairns, petroglyphs, and even potbusts, have been identified ethnographically and ethnohistorically as territorial markers. While it is not possible to say precisely what limitations of access are intended by such markers, some restriction of access is clearly being symbolized. Thus, to the extent that the use of such devices varies in time and/or space, increasing concern with access to space is indicated.

## Warfare

It is tempting to take evidence of warfare, in the form of mutilated bodies, etc., as evidence of territoriality. It is evident, however, that (especially prior to the

advent of state organized societies) warfare and raiding have no necessary connection with actual defense of territory.

## Architectural Features

Architectural features such as forts, defensive walls, garrisons, or signal towers are suggestive but not conclusive evidence of warfare and territorial defense. Nevertheless, it seems reasonable to assume that when a society reaches a point of making a major labor and material investment in defense, territory is likely to be an issue. Unfortunately, analyses of the spatial distribution of such features that could, for example, indicate that they bound a spatial unit or occur at key passes between different valleys, have rarely been undertaken.

## Art

Representational art can provide clues to the existence of more or less formally defined groups of warriors which must, as described above, at least strongly suggest a substantial concern with defense of territory.

Unfortunately, most of the evidence discussed above pertains largely to the more complex end of the political spectrum. In the case of simpler groups, one can only caution against overly quick territorial assumptions. While analysts should certainly seek to identify changing patterns of spatial use, these must never be confused with actual restrictions of access to space. It does seem likely that appropriate ethnographic, especially cross-cultural studies, might provide good indirect evidence of highly territorial behavior. For example, once societies are making substantial investments in the construction of features that improve agricultural land or create permanent dwellings, a greater concern with territory seems likely. At the same time, such correlations lead directly back to the problem mentioned earlier: if settlements with permanent architecture or the presence of intensive agricultural systems are taken as evidence of territorial behavior, one cannot study the relationship between the former and the latter.

The preceding discussion envisions harnessing all of the available distributional information concerning the study area for the purpose of identifying meaningful sociopolitical and sociocultural entities. The proposal is essentially to set aside the site-focused efforts of investigators such as Longacre (1970) and Hill (1970) and to begin with definitions of broader patterns. Fortunately, such an effort has already been undertaken for the late time period in the study area. Upham (1980) has done an analysis very similar to that outlined in the preceding pages. He has found evidence of site clusters that may represent local polities and of variation in the exchange ties between particular polities. Upham's work provides a more succinct and comprehensive model than can be described here. Extending his analysis into the earlier periods of time in the study area would accomplish the goals identified here.

# TEMPORAL VARIATION

Unlike the recent literature on spatial variation, current discussions of temporal variation are far from convergence. Whether the topic is as specific as the use of radiocarbon dating (Read n.d.), the contextual analysis of dated samples (Dean 1978) or theories of change (Plog, in press), the current literature places principle emphasis on the many problems that must be resolved if we are to deal with temporal variation effectively. Initially, I will summarize what seem to me the more salient points of these discussions and then discuss approaches to change studies.

The association between dated samples and artifact assemblages must be more carefully defined. When associational controls are not cautious, one runs the risk of rejecting viable temporal models. This problem seems to characterize the rejection of Wasley's horizon style system for Anasazi ceramics (1959), which Breternitz's (1966) tree-ring analysis of Southwestern ceramics appears to destroy. In point of fact, precisely what ceramic materials are associated with particular dated specimens, and in what quantity, is so highly variable that Breternitz's work cannot be considered a viable test of Wasley's model.

Chronologies must be recognized as hypotheses to be tested using a combination of chronometric and statistical techniques. In most instances, the most complete

chronologies (those applicable to the greatest number of sites) will be based on ceramic seriation. These should always be done first, with appropriate quantities of chronometric techniques employed to a sufficiently large number of specimens to permit statistical tests of the viability of the chronology. The odds that inappropriate specimens or techniques with too high an error factor will have to be used are so high that a meaningful test of an entire chronology is improbable.

Spatial correlates of temporal processes should not be assumed. In those few instances where historical records have been used to evaluate the presumed spatial correlates of a temporal process, e.g., diffusion from a center of innovation, great variation has been found. Moreover, when one infers temporal processes from spatial patterns, the use of evolutionary arguments to explain particular spatial phenomena is likely to become circular.

Observations should be made for a sufficient number of temporally discrete points. Too many archeological studies have been before-after studies. Growing evidence in both the social and natural sciences (Hamblin, Jacobsen and Miller 1974) suggests that unless 7 to 11 discrete points can be measured, the description of variation over time for any given variable is likely to be quite problematical.

Continuous, rather than categorical, variables should be preferred. By their nature, categorical variables reduce the variation with which an investigator can work. The essence of studying evolution or change is discovering the manner in which variation is shaped. While categories (tribes, chiefdoms, etc.) may roughly characterize the most common outcomes of particular change episodes, it is improbable that we will ever understand why particular structural configurations are more probable unless we employ techniques that allow the identification of the diversity from which they emerge.

Linearity of change processes should not be assumed. Linear change processes are extremely rare in both natural and social phenomena. One runs an immense risk in assuming linearity underlying dating techniques (as the radiocarbon experience indicates) and social processes.

Derivatives of variable trajectories should be investigated. For some social and natural science problems, regularities and patterning have proven difficult to identify when simple plots of variation over time were analyzed. When attention turned to the investigation of rates or even derivatives of change, substantial regularities were discovered.

Immediate causality should not be presumed. Again, in both natural and social scientific phenomena, dramatic changes occur as substantial lag effects, post-dating the triggering event(s) by substantial intervals. Systemic effects also confound efforts to deal with linear and immediate causality.

Explanations of change processes should focus on trends and not event-outcome connections. The same triggering event can have different outcomes and the same outcome can have different triggering events. It is for this reason that most natural science laws describe trends or tendencies, not events and outcomes.

Specific changes occur in the context of many other changes. Too many of our efforts to explain change focus on the environmental and organizational context in which the change occurs. A particular change may just as well result from some aspect of the change processes itself, as when an increase or decrease exceeds some limit and deviation amplifying processes are triggered.

There are, of course, many problems with specific models and theories of change, both in their structure and in their application. However, I would argue that the majority of these specific problems reflect difficulties in the overall approach taken to change studies, the way change is conceptualized, of the sort discussed above.

The focus of the preceding section has been on concepts for interpreting temporal variation. Most of the specific needs for investigations within the study area were identified in earlier chapters. Nevertheless, some conceptual coherence is essential if management strategies in the study area are to be interpretable with respect to one another.

## BUILDING PROCESSUAL MODELS

Explaining temporal variation necessitates building testable models for investigating the topic phenomenon. In this section, I discuss two aspects of that process, the definition of processual variables and the construction of processual models. Three different sets of variables will be discussed; long-term, short-term, and programmatic.

### Long-Term Processual Variables

Based upon his extensive analyses using the human relations area files, Naroll (1973) has argued that there are really only a few well defined lines along which human behavior and culture have evolved. In his analysis, these are in fact major differences among ethnographically described societies. But, there is good justification for arguing that there is archeological evidence for change of the sort that he envisions. While I have added some ideas of Flannery (1972), and redefined some of the terms for clarity's sake, I would suggest that the most important long-term changes in human behavior are measured by the following variables. (Sources of more operational definitions in parentheses.)

1. Intensification: change in the product derived per unit of land or human labor (Boserup 1965; Sanders 1973; Logan and Sanders 1975).

2. Specialization: change in the number of specialists; change in the percentage of the entire set of activities carried out in a society in which an average individual is likely to be engaged (Wright and Johnson 1975; Plog 1974).

3. Stratification: change in the relative access of individuals and groups to resources and power (Adams 1966; Sanders 1973; Tainter and Cordy 1978).

4. Nucleation: change in the size of settlements in which humans dwell; change in density (Swedlund 1975; Cook 1972; Baker and Sanders 1972).

5. Centralization: change in the extent to which sociopolitical and socioeconomic decisions are concentrated in the hands of a few individuals or institutions (Flannery 1972; Sanders 1973).

6. Differentiation (or diversification): the number of separate organizations or institutions (Flannery 1972; Plog 1974).

I believe that these variables describe the major long-term changes that have occurred and are occurring in human societies. When I say long-term, I mean that the periods over which changes occur is measured in centuries or millenia. This is not to say that they can't or don't sometimes change over shorter periods (that are called "revolutions") but that frequent radical changes are unlikely in an ongoing society.

I am not arguing that one can make laws of such trends, "centralization tends to increase," for example. Such a statement is nonsensical because centralization can clearly increase as well as decrease and has done so in the past. They are more properly regarded as consequences of many short-term processes operating within a society. But, they do provide a means for defining and using continuous variables to describe (a) differences between two societies at the same point in time, and (b) differences over time. Moreover, specificity and generalization are not opposed--the measure at each instant of time and the measure of change over time utilize the same variables.

### Short-Term Processual Variables

I recently suggested a list of variables for modeling exchange betweeen the inhabitants of different settlements (Plog 1977b). Before the article appeared in print, I discovered that Michael Schiffer (1980) had formulated a nearly identical list of variables in discussing how one might model an activity. In retrospect both of us were asking how one models an ongoing behavioral system and arriving at reasonably similar answers. We both begin with the notion that what is worth modeling is not the things (people, goods, institutions) of which a system is composed but the nature of the interaction between the parts of the system. In human systems this interaction most basically involves exchange of information and goods. Major variables that must be considered to accurately describe such a system follow:

1. Content: the things that are being exchanged.

2. Size: the number of people involved in the exchange.

3. Magnitude: the quantity of things that are being exchanged.

4. Diversity: the number of different kinds of things that are being exchanged.

5. Frequency: the incidence of exchange in time.

6. Duration: the length of the exchange.

7. Territory: the spatial extent of the exchangers.

8. Directionality: the direction (one or many) in which the goods or information flow.

9. Symmetry: the relative quantity of the flows in each direction (even or uneven).

10. Centralization: the extent to which the exchange is centrally regulated.

11. Complexity: the extent of variation in the first 10 items from area to area and time to time in the operation of the system.

Again, each of these is a continuous variable; changes in each can be plotted over time. Moreover, the same variables are relevant, whatever the scale of analysis--a few individuals, a settlement or a series of interacting settlements. Changes can be, and are, relatively short-term occurring over days, weeks, and years, although longer periods are also possible. There are two other aspects of the variables that are appealing: (1) they are characteristics of the entire system; not simply a part, they synthesize a critical bit of information that relates to the entire system; and (2) they are dynamic. In passing, it is noteworthy that moving from a focus on things to a focus on interaction has been critical to the growth of most disciplines.

## Programmatic Variables

Throughout the discussion thus far, I have talked of temporal variables as if they were almost exclusively described by lines on a graph. Obviously there must be words, variables, that can be used to describe these lines. I suspect that four variables are both necessary and sufficient for describing any temporal process:

1. Magnitude: the scale over which variation occurs 101, 102, 103, 104, etc.

2. Amplitude: the height of the curve.

3. Frequency: the duration of cycles, if any.

4. Slope: the overall direction of the curve (up, down, constant).

Having defined such variables, they too can become parts of particular causal models.

## Underlying Assumptions

However neat the models and concepts, some notion of people and what they are about must be the basis of any approach. Some of the most important current ideas have, in fact, grown out of elements used to build a more dynamic evolutionary theory in biology. I rely here, in particular, on the works of Slobodkin (1968, 1972) and Holling (1973).

In modeling change it is necessary to remember that people have a number of alternative responses that they may employ to a change in their situation; alternative behavioral, cultural, and physiological responses are all possible. Behavioral and physiological changes can obviously occur far more quickly than cultural ones. But all are possibilities; all must be explored in relation to the specific change in question.

In nature, the only constant is change. It makes no sense to try to explain behavioral or cultural changes by citing a change in the natural environment; people are adapted to change in their environment. One may attempt to demonstrate, however, that the magnitude, duration, frequency, or novelty of a particular change is sufficient to drastically alter the circumstance in which people find themselves.

By the same token, evolutionary success is a matter of resiliancy, not stability. Stability is a measure of the ease with which a system returns to equilibrium after absorbing disturbances. Resiliency is a

measure of the degree of change it can undergo while still maintaining its basic elements or relationships. It is the resilient, not the stable, who inherit the earth. But, how does one measure resiliency? Human numbers are an initial factor; the more expendable bodies in a system, the greater its resiliency. But, clever (not wise) strategies for adapting (not proper, but smart, in Frielich's [1973] terms) are what ultimately make the difference.

If resiliency matters most, then it makes sense to think of evolution as an existential poker game the object of which is simply to stay in the game. Optimization and maximization are probably less accurate descriptions of what people strive to do than satisficing (Isard 1975) or coping. Most people, most of the time, are not involved in inventing clever strategies to acquire the most poker chips possible for the least effort. They are simply trying to get by.

In evolution there is a demographic baseline. Given instability, given that the prehistoric peoples continually faced changes in resource availability and in their own numbers, two strategies were possible: (1) limit population; and (2) increase the production of resources, (intensify). Both strategies effectively solve the problem. But, strategy one results in a retardation or cessation of growth while strategy two does not. The members who practice the latter become more numerous relative to those of the former. It is for this reason that the earth is not populated by hundreds of small stable societies effectively balancing resources and their own numbers but rather by rapidly growing and rapidly declining societies.

Preliminary studies along the lines suggested above have been done in many areas. And, there are other studies that could be done almost immediately. However, much of the temporal detail of prehistoric activity in the overview unit cannot be described until more and better chronological techniques are employed and the resulting data are handled using variables that are amenable to study through time.

# REGIONAL PLANNING: THE SIGNIFICANCE ISSUE

Regional planning is an effort to insure that cultural resources are never casually destroyed and to avoid the costs of protecting expendable resources. If we fail in the former, we will be the parties most responsible for the destruction of our resource base. If we fail in the latter, others will justifiably insist on the right to make for us decisions of which we have proven incapable. A pivotal concept is significance. In this section, I will discuss the issue at a general level and turn to more specific implications later.

It is safe to say that only a decade ago few archeologists had given meaningful thought to the significance of archeological sites. Certainly there were sites of sufficient importance that they were declared National Historic Landmarks. Others attracted excavation projects. Similarly, there were sites worth salvaging and those that weren't. But, the boundary between sites that deserved preservation and those that did not was largely unexplored.

For reasons familiar to archeologists, that situation has dramatically changed. There are several extensive and insightful explorations of the concept (King, Hickman, and Berg 1977; Schiffer and Gumerman 1978; Moratto and Kelley 1978), and also of the conservation and preservation ethic from which such a concept is derived (as above; Lipe 1974). These treatments are themselves summaries of the use of the significance concept in hundreds of specific resource evaluation studies.

Despite the immense growth in the precision with which most archeologists understand and define significance, despite the growing concord within the professional community, we are told that there is a problem with significance (see especially ACHP 1977). The problem is described in a variety of ways. According to some, the definition of the term is simply unclear. According to others, the concept has been extended in application to include sites that are not significant under the original intent of the pertinent legislation, executive orders, and Code of Federal Regulations. According to still others, the concept generates preservation processes that are too slow and too expensive for proper government planning. Again, if one believes the Advisory Council on Historic Preservation's (ACHP) "Issues in Archaeology" (1977), there is little that goes wrong in conservation planning that is not blamed on significance. As a result, the concept of significance is the major focus of the ACHP task force currently studying the archeological preservation process.

It is appropriate to step back from the emotion of the current concerns and ask what a concept such as significance should accomplish and whether or not the current definition meets those standards.

## EVALUATING THE UTILITY OF SIGNIFICANCE

It is easy to say that the ultimate measure of the utility of any concept is its clarity. In point of fact, some of the most critical concepts in any profession are of dubious clarity--one need only mention the thousands of pages that have been spent in exploring the meaning of the term "culture." Nor is such ambiguity the exclusive property of academics. Were legal concepts and their meaning exquisitely clear, courts of law would consider only neat questions of application, not the tortuous issues of interpretation-in-application that form the theoretical basis of the legal profession and consume years of court time.

Certainly, there has been a problem in the clarity of the term. Two literatures exist, one within the federal archeological community and one within the academic archeological community, that explore the meaning of significance. There is, I think, remarkable agreement on pertinent issues given the limited interaction between the two communities. Moreover, relative to the time spent in defining and redefining most legal and quasi-legal concepts, the evolution has been quite rapid. Finally, I think, there is little doubt that, were the members of the academic and federal communities who have invested the greatest effort in exploring the concept to meet, still greater clarity and agreement would result.

Despite the existence of the literatures, and irrespective of my claims of increasing agreement on the abstract meaning of signi-

ficance, there is the separate but related issue of its clarity in application. Some argue that the lack of clarity in the case of specific sites is the real problem, or that inconsequential sites are being called significant. The implication is that sites' significance ought to be immediately obvious and that the significant sites are the larger more interpretable ones. There is sometimes the further implication that the problem of significance is unique to archeological sites: because they are beneath the ground their significance is not manifest.

I observed earlier that few legal or professional concepts could meet the standard of clarity that underlies arguments such as those discussed in the preceding paragraphs, especially in so short a time. The problem is, I think obvious--significance is a pivotal concept in a legal and political process. As is the case with any such concept, parties with different interests in a particular case will seek to interpret the concept to their own ends. Two examples may illustrate the problem.

In a recent study of a highway right-of-way, a small historic structure was located and determined to be the homestead of the Correjo family who settled in the area in question about 85 years ago. In due course, the issue of the site's significance was taken to the ACHP and the National Register where it was determined that the site possessed integrity, was reflective of a distinctive architectural style, and reflected important events in the area's history. The historic archeologist who undertook the on-the-ground evaluation of the site noted that the main structure was marked by only three courses of wooden logs and that if this site was significant there were tens of thousands of other such sites that would eventually clutter the register. It is difficult to conclude from this case, that the problem of inconsequential sites is uniquely prehistoric; historic sites are equally a problem. The real problem is either political or administrative, but, in any case, reflects inflexible adherence to a misinterpretation of the ACHP's guidelines rather than a legitimate question of significance.

A second case involves a site that covers an area of more than a square mile, a site at which limited and unsystematic excavation was done in the 1920s. A 22-foot deep, 8 lane freeway will be excavated through 2.3 linear miles of the site. Existing evaluations of the site's significance are based on surface remains because the agency in question refuses to undertake testing until a final right-of-way decision is made. Professional opinion ranges from a conclusion that the site is significant to one that it lacks both integrity and significance. While the disagreement is phrased in terms of significance, the real problem is the failure to undertake preliminary studies of the sites at an early point in the planning process. In any case, the problem of significance does not arise only in the case of small sites but can clearly occur in the case of very large ones.

Interestingly, in both of these cases the concept of significance serves to structure the controversy. The concept is certainly not the origin of the controversy. Structuring and thereby helping to clarify the controversy is, I submit, the function of a good concept. To blame the concept for the existence of the controversy is nonsense.

## CONSISTENCY

A final consideration, the basic one I think, is whether the concept can be applied consistently. Surely, a major problem exists if a concept is defined in such a way that there are inherent inconsistencies when it is applied in different situations. One might envision two areas in which such inconsistencies might arise in the case of significance: the application of the concept in different cultural regions and its application by different agencies with different missions.

The cultural resources of different regions are, of course, highly varied. Sites can be marked by adobe or stone walls, by mounds, or by no more than a thin scatter of artifacts. But, it is not the kinds of artifacts or architecture found on most sites that make them significant or insignificant, it is primarily their potential for yielding information important to understanding a variety of different aspects of prehistory. Even should the specific central research problems vary from one region to another, the relevance

of a particular site to those problems remains the key issue.

There is no question that the application of the term in specific contexts will vary with the nature of the research problems and the abundance of sites at which those problems might be pursued. However, the problems resulting from this variation will be resolved by more complete regional overviews and inventories, far superior to any that currently exist, and more precise models predicting the abundance and distribution of particular site types.

Does the definition produce inconsistencies when applied by different agencies with different missions? Clearly "land management" and "project" agencies encounter the archeological record in very different forms. Land management agencies are dealing with millions of sites on millions of acres of land, while project agencies attempt to cope with a few, a few dozen, or a few hundred sites on typically small and spatially disparate (e.g., highway rights-of-way) parcels. Interestingly, it is not the land managing agencies caring for millions of sites, many of them "inconsequential" in some sense of the term, who find a problem with significance.

Project agencies do face a special problem because a single project involves only a few sites. It is difficult to assess significance against a background of knowledge of the abundance of particular site types in the area when project funds cannot be used to develop that background. But, this is a problem that is best resolved by the creation of high quality overviews and long-term planning documents. It is difficult to see that a definitional change will resolve the issue. Moreover, I suspect that for some agencies the real complaint is reflected in statements such as the following:

> . . . once you go to work for the Federal government in the area of historic preservation, you all but become automatically suspect in the broader academic world. (Weakly 1977:20-22)

> The States are faced with a slow down of Federal funds which causes them to resist the compliance, not as a matter of fact, but to see what they can get away with to prevent delays. (Crecco 1977:32)

> We anticipate pressure being exerted on our agency, and I wouldn't be surprised if it fell on other agencies as well, to expedite projects at the expense of the existing cultural preservation system. (Olson 1977:46)

Again, while there are agency complaints concerning significance, the overwhelming majority of the specifics seem to concern procedure. Will not these complaints exist whatever the definition that is used to evaluate the need for conserving/preserving specific resources?

## THE ALTERNATIVES

Authoring an impassioned defense of the status quo is not an activity in which I have great experience. Yet, to this point I have done just that. As I have argued, the problems I perceive are not with the definition of significance but with the context in which that definition is now used. I wish to go further and suggest that some of the proposed alternatives either do not solve the current problems or make them worse. None of the proposals I will discuss are the unique creation of a single individual, and I do not intend to attack any specific proposal or its author.

A first proposal has been to create a checklist or scorecard of characteristics that a site might possess. A site with a sufficiently high score would be considered significant. There are a number of problems with such a proposal. First, an inflexible quantitative boundary between significant and nonsignificant sites is necessarily arbitrary and will result in arbitrary decisions concerning cultural resources. Second, it is doubtful that a single list of criteria can be applied nationwide. Sites in some regions and some types of sites will almost necessarily receive lower scores. That is to say, the procedure would almost certainly result in inconsistencies. Third, the use of such a system would require overviews and planning studies that do not currently exist. Fourth, such a procedure violates the spirit, if not the letter, of pertinent legislation. Finally, such lists would increase the quantity of grounds for arguments about archeological sites. Rather than phrasing debates in terms of a central concept and arguing about its interpretation, as many as a dozen criteria could

become bases for dispute. The discovery of the type-variety system did not stop the proliferation of taxonomic units; it simply shifted the growth in numbers from types to varieties. Similarly, writing a more detailed definition of significance will not stop the proliferation of arguments concerning significance, but will increase the grounds on which arguments can occur and, ultimately, their number.

A second proposal is to create a master list of significant sites that is either a real "honor roll" or a random sample of sites or some combination of the two. Such an approach presumes the completeness of our understanding of the archeological record in two ways. It presumes that no new sites of significance will be found and that we will continue to evaluate the significance of particular sites and site types exactly as we evaluate them today. Were protection extended only to such a list of sites, much of the progress of recent years would be destroyed.

While the complaints concerning significance are obvious to us all, the successes are rarely so evident. For example, on land managed by the Forest Service and the Bureau of Land Management, thousands if not tens of thousands of sites that would have been casually destroyed in the past are nearly effortlessly saved by small changes in project locations. These are made by staff archeologists, paraprofessional archeologists, and managers of other resources who have been sensitized to the ease with which cultural resources can be preserved when there is an appropriate planning process. It would be folly to undercut a structure that results in the preservation of so many sites with so little friction by denying cultural resource managers the option of simply presuming significance. Yet, any effort to tighten the definition of significance would do just that.

## PLANNING: IMPLEMENTING SIGNIFICANCE

If the definition of significance is not a problem, its implementation certainly is. And, it is precisely the preparation of sound regional plans that will render implementation less problematical. Sound regional plans are ones based on quantitatively and qualitatively acceptable data bases.

It is increasingly evident that something between a 10% and 20% sample is adequate for most studies in most natural and cultural circumstances as long as the sample unit is small and the number of observations correspondingly large. A recent study by Stafford et al. (1978), strongly suggests that much of the argument in the current literature concerning the size and shape of survey units and the efficacy of different strategies is misleading.

When variation in the number of observations is controlled for, such considerations are far less important than once believed. After the 5% (and especially after the 10%) sampling fractions have been surpassed, information gain for each new unit surveyed drops drastically. Past 20%, the new information gain does not justify the greater expense. Of course, there are still archeologists who object in principle to sampling.

Evidence grows that even very small samples (ca. 2%) of large regions generate information on thousands of sites, more than we are methodologically capable of handling. As the way in which the highly selective survey procedures of an earlier archeological generation essentially constituted a sample the biases of which cannot be described or even estimated, such arguments lose credibility. Even when a complete inventory of sites in a region will eventually be undertaken, sampling is basic to designing a program that will ensure the wise expenditure of survey dollars.

Qualitatively, a data base must be evaluated against the best ongoing research methodologies appropriate to the region in question. It is precisely those standards that I have tried to summarize at a general level in the early sections of this overview. I wish at this time to identify somewhat more specifically the planning information that will be foregone and the risks that will exist if information meeting these standards is not developed.

### Transformation Processes

My concern here is principally with the effects of natural transformation processes. While there are potentially important effects of cultural processes, a full understanding of these will require

new analyses of excavated materials the conclusions of which can be extrapolated to survey situations.

A careful review of major land modifying activities that have been undertaken in a region is both necessary and relatively simple. While one might argue that for a small locality the effect of natural transformation processes is likely to be negligible, for an entire region the opposite is true.

Of particular importance are the effects of erosion and deposition since, at least in principle, these agents are capable of enhancing the visibility of cultural remains in some contexts and obscuring it in others. Checking for such effects is not difficult: when archeological sites cluster on geomorphologically stable ridges and are rarely found on alluvial plains, natural transformation processes should be immediately suspect. We serve our interests poorly if we fail to identify environmental contexts in which sites with little surface evidence occur since any deep land modification activities will destroy these resources.

## Spatial Variation

Failure to generate a relatively complete description of cultural resources as outlined earlier creates two problems. First, unless the nature of spatial variation is understood in some depth, one runs the risk of permitting the expenditure of cultural resources on the assumption that they are not significant when in fact they are. Were we to believe that sites are sites are sites, we would randomize our protection of the cultural resource base and our understanding of it. The more refined our control of spatial variation, the greater our ability to differentiate critical from common resources, the greater our ability to wisely invest in the use of particular resources.

Second, understanding spatial variation as described earlier is in itself a planning tool. The generation of predictive models on the basis of environmental correlations is an example. On the one hand, controlling for transformation processes, this information is an aspect of understanding prehistoric behavior. On the other, it permits us to identify environmental contexts in which sites are likely or unlikely to be found and to assess particular projects with such a background.

Similarly, knowing the spatial distribution of cultural resources can greatly aid planning efforts. Even assuming that one is discussing areas in which site densities are high, it is useful to know something of the evenness of the distribution, for example. Depending upon the particular proposed impacts, it will be more or less easy to design a project in such a way that impacts will be minimized depending on whether points in the area are randomly, evenly, or unevenly distributed in relation to the proposed project zone and available alternatives.

## Temporal Variation

The relationship of temporal variation to the planning process is less direct. Many of the specific pieces of information generated pertain to understanding the archeological record more than to managing it. Nevertheless, unless temporal variation and processes that need to be understood are clearly identified, one runs the risk of expending resources that represent potentially crucial pieces of information. Similarly, as we begin to understand such processes, it becomes possible to evaluate the impact of a particular project not in respect to a temporally homogenous data base but in respect to a more refined notion of the importance of particular sites to particular research efforts.

Given an understanding of the above, the class of significant sites consists of the quantity of distinctive sites of pertinent site types necessary to ensure an understanding of regional prehistory through the application of identified research strategies.

# MANAGING CULTURAL RESOURCES

The discussion to this point has focused on assessing current understanding of cultural resources in the overview unit and identifying research efforts that are necessary for a more complete understanding of those resources. At issue now are management strategies that will ensure a framework in which that research can be completed as opportunities arise. Five such strategies can be defined: (1) completion of management planning and the inventory effort in the study area; (2) protection of resources from other land use activities; (3) regulation of consumption of the resource by the scientific community; (4) regulation of the consumption of the resource by the public; and (5) administrative studies. Each of these is addressed separately.

## PLANNING AND THE INVENTORY EFFORT

A management plan for the portions of the overview unit under Forest Service administration has been completed. A management plan based on a Phase II effort (sample survey) for Bureau of Land Management and other agency lands has not yet been written. It will be difficult to pursue a management plan on Bureau of Land Management and other agency lands using the same strategies employed on the National Forests. The National Forest is a contiguous spatial unit. Remaining agency lands are discontinuous units. Moreover, and as a result of the spatial situation, planning needs necessary to inform wise management decisions are somewhat different since decisions must often be made that compare a 1 square mile parcel in one location with another several miles away. Such considerations must be based upon statistically valid information. Without multiple observations of each parcel statistical validity is impossible.

I, therefore, propose that the Phase II effort involve survey of 15 small units in each section under the jurisdiction of the agency conducting the survey. Fifteen observations are sufficient for a statistical comparison of the cultural resources of two populations. These sample units should be 50 yards wide and 120 yards long. This coverage is equivalent to a single transect used for planning purposes on the National Forests. Ten of the sample units would be chosen using a random systematic design to ensure even coverage of the area but with reduction of bias. Five might be placed in "likely locations" of cultural resources thereby allowing a judgmental effort to enter the survey design.

Thus, management information might be generated using two procedures. First, as management needs require the survey of particular parcels, those parcels would be sampled following the strategy identified above. Secondly, in a single contract or in several smaller contracts as funds become available, survey of remaining parcels would be undertaken. In combination, these two mechanisms should result in the generation of information necessary for a management plan within a period of a few years. In the meantime, management decisions could use available information for parcels with prior survey or generate new survey information.

Only one viable alternative methodology exists. If the Bureau of Land Management and other agencies holding dispersed parcels within the study area are willing to assume the risks of a nonprobabilistic sample, the risk of unstatable biases, then Phase II and Phase III planning (inventory) might be combined in the following manner. In any parcel, a block representing about 25% of the land surface of the parcel will be randomly selected for survey. Upon arrival in the field, the survey archeologists will have discretion to break this survey unit into two parcels. The situation under which that decision might be made would include suggestive evidence of high variation in the density of cultural resources, clear indications of extreme environmental variation, or both. Such a procedure would provide "some information" about each parcel held, but would lack the generalizability of the first approach discussed. On the other hand, it is a good compromise between "planning" and "inventory" goals, if one allows such a compromise.

## INVENTORY GOALS

As originally envisioned, the consideration of future plans for obtaining an inventory of the cultural resources of the study area was to identify a series of programmatic goals consistent with agency deadlines.

Considering the various topics discussed herein, such an approach to cultural resources in the area seems unproductive. First, such an approach presumes that the primary goal of future research concerning cultural resources and their distribution is to obtain as complete as possible a catalogue of what is there. This goal makes no more sense than the presumption that successful management planning requires an inventory of every tree or every acre of grazing land within the study area. Clearly, one can plan for a timber harvest program or one for grazing without such detailed information. In the same manner, one can plan for the wise management of cultural resources without knowing where each and every one of them is located.

The original inventory goal assumes a set of conditions that may exist on some, perhaps most, public lands but not those in question here. The assumption is that cultural resources are relatively rare. It is difficult to speak of tens of thousands of cultural resources as a rare resource. That the resource is nonrenewable is clear. That without wise management it will disappear more quickly than many other resources, is clear. That each and every cultural resource must be described in the same detail is unclear.

The investigative strategy required to know every resource in even approximately the same detail would be wasteful of the tax dollar. There are places in the overview area where the probability of encountering cultural resources is close to zero. Yet, the dollars required to inventory those acres differ insignificantly from the dollars required to inventory acres on which cultural resources occur in abundance. The major expense incurred in inventory work is getting to a cultural resource. In this sense, whether the result of an effort to get to a cultural resource is successful or unsuccessful, the expenditure is relatively the same. Thus, the question of means of accomplishing the inventory goal without pedestrian survey of all public lands in the area is a critical one.

Such an effort is inconsistent with a multiple-use philosophy. Some resources are critical because they are used, trees for example. Others are important because their protection is in the public good. In the case of the latter, inventory is crucial to the extent that use activities sometimes have ill effects on protected resources. If land use is not occurring in a particular location, impacts on cultural resources are unlikely.

Finally, an effort to achieve an overall inventory is unnecessary because the "consuming public" would have no use for its results. There are two possible constructions of the consuming public in regard to cultural resources, those who use them for recreation--the general public--and those who use them for knowledge--the scientific community. It is obvious that the general public has no concern for such a resource in the quantity of tens of thousands of cultural resource loci. Scientific strategies for utilizing the evidence from tens of thousands of cultural resource loci do not exist at present, are unlikely to exist in the foreseeable future, and will be superceded by more economical strategies in the distant future.

For all of these reasons, it seems preferable to discuss the inventory problem not in terms of goals, such as acres surveyed or sites recorded, but in terms of how to achieve an increased understanding of how these resources can be routinely preserved and conserved as more "consumptive" activities are carried out on public lands. This can be done in much the same way as projects are defined so as to avoid major watershed impacts. This is not to say that there are no plans for the consumers that need to be formulated. These will be discussed later. The point made here is simply that there is a difference between the inventory task on the one hand and provisions for the wise use of the resource on the other. This last question will be discussed in a later section.

An inventory plan should articulate with other land use activities. When a particular area is to be impacted because of a timber harvest, land exchange, or road construction, the designation of that area for a cultural resources survey is essentially random in regard to the cultural resources. The growth of the inventory in conjunction with, rather than separate from, other forests goals is ultimately consistent with archeological as well as management goals.

There is no justification for additional transect surveys for planning purposes on

the National Forests. The distribution of resources described for the Apache-Sitgreaves National Forests is probably as good as can ever be achieved using such a device. In fact, and given that hindsight is always 100%, current conclusions (Plog 1981) could have been reached with approximately 25% less effort, which--given that a substantial part of the effort was at no expense to the Forest Service--equates with about 10% less expenditure by the Forest Service in relation to the current project, given the substantial volunteered time.

Transects are an inefficient inventory unit for further research, even though they are an efficient planning tool. Inventory is best accomplished in more sizeable areas. There is ultimately some indecision as to which sites have been recorded and which have not, what areas have been surveyed and which have not when transects are used as a primary tool. Moreover, the critical planning information that is not contained, but only suggested, in this report is local variation in site distributions. Only through the survey of relatively large blocks of land evenly spaced over the study area will such information be obtained.

Project areas are not always of a size useful for inventory purposes. Small and sinuous project areas provide a limited basis for spatial generalizations. For this reason, it will often prove useful to attach inventory dollars to project dollars to increase the size and regularity of the boundaries of a study area. In this way, inventory goals and other planning goals can be accomplished together.

There are some portions of the study area for which pedestrian survey is an inefficient means of obtaining an inventory. In those areas where site densities are high the cost of obtaining an inventory record, assuming a standard survey cost of $10 per acre, is about $160. Where site densities are very low, the cost rises to $6400 per site (if only a single site is found). While some gains in the efficiency of survey in low density areas are realized, the strategy is still not cost effective.

In areas above 8200 feet, for example, cultural resources likely to be found include shrines and historic sites. The former may often be documented using a check of likely loci--springs, peaks and promontories. The latter are perhaps best documented, although clearly not exhaustively, by records searches. None of this is to argue that every specific project will not require some effort to identify, conserve, and preserve cultural resources, only that the identification of all such resources is not best accomplished through an inventory effort.

These same conditions will exist in the more arid, desertic, portions of the overview unit. While the nature of locations where sites are likely to occur is not clear at present, studies could clarify its meaning and lead to far less expensive survey efforts.

With these goals in mind, an inventory is probably best accomplished through a number of activities.

1. Drawing upon the conclusions of this study, an effort should be made to identify the boundaries between areas with, and areas largely devoid of, cultural resources.

2. In areas where the density of resources is likely to be quite low, the inventory effort should focus on checks of likely locations in the case of prehistoric resources and on records searches in the case of historic resources.

3. In areas where site densities are likely to be high, an initial 10% survey should be used to define specific areas where resources occur. A 100% sample should be designed on the basis of the information obtained in this preliminary stage.

4. Where project areas are small and/or irregular, inventory dollars should be used to create larger and more regularly bounded study units.

5. Given identified needs for resources on public lands, inventory dollars should be used to fund studies lying in areas where immediate project needs are not substantial.

6. The immediate goal of such efforts should be greater understanding of local variation in cultural resources so that projects can be defined so as to avoid them. The long term goal is inventory.

A survey of the entire unsurveyed acreage within the study area would cost over $20

million assuming an average cost of $10 per acre during the time that the survey is done. Such an expense is unjustified from the perspective of wise planning for the preservation and conservation of cultural resources. The $10 per acre figure converts to a cost of roughly $700 per resource. There is no consumer of the resource that requires the information generated by such an expenditure.

If inventory survey is focused on areas where sites are likely to be found, the cost can be greatly reduced. For the specific case of public lands administered by the Forest Service, the reduction would be to about $305 per resource. Even at this level of activity, the cost is high and the availability of necessary manpower to conduct the survey within a reasonable period of time dubious. By further refinements of the need for inventory survey in specific areas, cost can be further reduced. These refinements include the identificaiton of areas where checks of likely site locations are a more justifiable tool than generalized survey. In the case of the forests, the proposed plan would result in a cost of about $160 per resource. For the entire overview unit, an expenditure on the order of $7 million would be required. While high, the cost is far below the initial $20 million figure.

## PROTECTION FROM LAND USE ACTIVITIES

An earlier section of this document discussed the nature of impacts and described strategies either currently in use or that could be developed for avoiding further impacts to cultural resources. The continuation and improvement of these strategies is the primary basis for protection proposed in this study. One question remains, however: how to proceed when a situation arises where impacts to at least some cultural resources are unavoidable.

The answer to this question presupposes some effort to complete the inventory of the study area along the general lines just discussed. I will use the Apache-Sitgreaves National Forests as an example and assume that there are about 18,000 such resources on the National Forests distributed among site types in the manner shown in Table 33. Further inventory will certainly result in the refinement of these figures. I also assume that it is unlikely

Table 33. Numbers of Prehistoric Site Types

| Site Types | Numbers |
|---|---|
| Surface habitation structures Pueblo | |
| 1 room | 1731 |
| 2-5 rooms | 3159 |
| 2-5 rooms, with kiva | 87 |
| 6-9 rooms | 476 |
| 6-9 rooms, with kiva | 43 |
| 10+ rooms | 619 |
| unknown number of rooms | 173 |
| Pithouse structures | |
| 1 room | 649 |
| 2-5 rooms | 433 |
| 6-9 rooms | 43 |
| Combination of surface and pithouse structures | 303 |
| Artifact scatters | |
| 1-9 square meters | 173 |
| 10-99 square meters | 1211 |
| 100-999 square meters | 3894 |
| 1000+ square meters | 865 |
| unknown square meters | 260 |
| Lithic scatters | |
| 1-9 square meters | 43 |
| 10-99 square meters | 260 |
| 100-999 square meters | 606 |
| 1000+ square meters | 130 |
| unknown square meters | 43 |
| Ceramic scatters | |
| 1-9 square meters | 87 |
| 10-99 square meters | 303 |
| 100-999 square meters | 216 |
| Water control features | 822 |
| Kivas, alone | 216 |
| Rock ring or amorphous rock structures | 563 |
| Petroglyphs | 43 |
| Historic | 130 |
| Rock shelters | 216 |
| not enough details | 606 |

in the case of projects that have major impacts to acquire the level of funding sufficient to mitigate by a data recovery program all of the resources that are to be impacted. Given all of these assumptions, the quantity of such resources available for study and their distribution on different districts should serve as a major guide to decisions as to where mitigation dollars should be directed.

For example, the most abundant site type on the National Forests is an artifact scatter between 100 and 999 square meters in area. There are potentially 3894 such sites in the study area. There have been five excavation projects done at such sites in the last 20 years. If these sites are used by the scientific community at the rate of one every four years, the resource would not be spent until the year AD 17,555. By that date, archeologists, if they still exist as an identifiable profession, will be studying the archeology of us. To the extent that prehistoric materials are still necessary to archeological research, improvements in site discovery techniques, and in the economy of analytical techniques (not to mention the vast amount of pertinent materials that will be stored in museums and at universities), will probably assure the adequacy of a data base in ways that we cannot currently envision. In the context of a multiple use philosophy, the expenditure of funds to protect or improve some other resource seems far more justifiable than the protection of cultural ones.

At the same time, the distribution of such resources must be taken into account. For example, in the case of artifact scatters of the size we have been discussing, there are 33 times the number of such resources on the Pinedale Ranger District as on the Alpine Ranger District. On the Alpine District they represent a far rarer resource and are therefore more crucial to interpreting the prehistory of that district.

Clearly, the boundary between these two districts is not a cultural boundary and, therefore, variance estimates might be further refined. However, the boundary between the two districts is a natural one and, therefore, may have been a cultural one so that the estimates are unlikely to be very far out of line.

It must also be recognized that there are within the study area very scarce resources. Compounds, defensive sites, and multi-hundred room pueblos are examples of known rare sites. PaleoIndian sites are examples of types that may be present although they are not currently identified. These very rare site types warrant the highest degree of protection, especially in regard to vandalism. The utility of formulating a list of eligible or "super-eligible" sites is dubious. In the absence of detailed field inspection, the current integrity of many of the sites on which records have now been assembled is also dubious. Similarly, the probability of highly significant sites that have not yet been inventoried is dubious. I cannot honestly respond to the issue of which sites within the overview unit are most worthy of nomination to the register on the basis of available information.

## THE SCIENTIFIC COMMUNITY

Archeologists are one major category of potential user of the cultural resources on public lands. Unfortunately, despite the use of the "conservation-preservation ethic" to ensure enlightened treatment of resources by public agencies, there is still some insensitivity to the resource impacts created by archeologists themselves. In one recent case, an archeologist working in Arizona chided the Forest Service for its insistence that a road be moved to avoid impacting a prehistoric site when the Arizona Department of Transportation (ADOT) was willing to pay for the excavation and the archeologist was interested in undertaking it. Such a position is clearly inconsistent with the ethic in question. But, it is no less inconsistent than the behavior of a doctoral dissertation committee that fails to insist that students demonstrate the need to pursue a particular research project using newly recovered materials rather than existing collections. The profession as a whole has invested little effort in exploring the strengths and weaknesses of such collections, presuming that they were collected using techniques that are below current standards and thus they are totally useless.

For these reasons, it is entirely appropriate that public agenices develop their own strategies for ensuring that the resources they seek to protect are never taken unnecessarily. While this discussion is of one particular area the amelioration

of the problem will most likely result from a coordinated effort at the regional level. If different agencies, not to mention administrative units within them, have drastically different policies, more resources will be taken on some land than others and our understanding of the regions history and prehistory correspondingly biased. A first step in that direction would involve systematic review of all research proposals by the appropriate representatives of different agencies sitting as a panel.

The subject of their review should be a document that is both a research design and a demonstration that the resources that will be taken are essential to the success of the project in question. I use the term "essential" purposefully. The greatest percentage of the region's cultural resources exist on private land, where they are totally unprotected, or on State lands, where the level of protection currently given them is far less than desirable and far less than that characteristic of Federal lands. It is preferable that the scientific community take resources from State and private lands, leaving the better protected ones on federal lands as a storehouse for the future.

Drawing upon the general literatures of anthropology and archeology and others that will undoubtedly be generated in the near future, a number of questions should be addressed.

1. What are the theoretical, methodological, and empirical goals of the project?

2. What specific theoretical, methodological, and empirical advances would result from the project?

3. What categories of data are necessary to the completion of the project and in what quantities must these data be available given the inferential techniques that will be used in the study?

4. Why are data from federal, rather than from State or private, land essential to the success of the project? What are the available options on the latter and why are these unsatisfactory?

5. What existing collections have been evaluated in regard to their adequacy for the study? Why is the recovery of new cultural materials essential to the success of the project?

Clearly, this list could be elaborated and the level of detail increased. But the above questions identify the general grounds on which particular projects can be evaluated, to determine whether the taking of new resources from Federal lands is essential.

## INTERPRETIVE PROGRAMS

The goals of preservation-conservation and of interpretation are closely related. On the other hand, there is little justification for spending public monies on the conservation of cultural resources unless there is a social value to the product, that is, unless the resources are actually resources. Interpretation of those resources is the only means to that product both through the enjoyment that citizens obtain through seeing the material remains of past cultures and the education that results from actual interpretation of the lifestyles of prehistoric peoples. Education can be both direct and indirect. Direct education occurs when a cultural resource becomes a part of a display, exhibit, lecture, or publication that is readily available to the public. Indirect education occurs when the resource is used to contribute to understanding the past but in a more mundane scientific fashion; the results are in relatively inaccessible publications.

On the other hand, interpretation is essential to the conservation and preservation of cultural resources. The expenditure of funds that would be required to stop the destruction that is now occurring to sites on public lands because of illegal collecting and excavation would be close to unimaginable and might very well not succeed. Neither will new legislation, however high the attached penalties, cause this criminal behavior to stop. Tighter laws and stricter enforcement will ultimately increase the value of antiquities and the willingness of pothunters to continue their efforts. This is not to say that legislation and stricter enforcement are not partial answers. Indeed, they are necessities. But, there must be positive reenforcement along with the negative. Preservation and conservation will ultimately be based in a concerned local

community that sees efforts to protect cultural resources as an integral part of maintaining the community.

Changing a community's attitudes toward cultural resources will not be an easy task. But, given the level of destruction described earlier, a negative attitude toward collecting and pothunting is a cost effective check on those activities. If concerned citizens begin to report such events, the burden falling on the agencies is greatly decreased. If citizen awareness grows that their illicit activities may be reported, they will be less likely to engage in them. Similarly, a citizenry that is aware of the potential benefits of preserving the resources--benefits such as increased visits to the area and prolonged lengths of visits--is more likely to accept the necessity of protection and participate actively in it.

## Awareness Program

Goal: To increase local awareness of cultural resources and their value to the local community.

The ability of different agencies to participate in interpreting cultural resources to the local communities varies. The Forest Service has a permanent presence in the area, the Bureau of Land Management does not, for example. Similarly Forest Service lands are contiguous while those administered by other agencies are not. For this reason, the roles that different agencies can play in increasing awareness is different. This discussion is of the overall nature of such a program with the recognition of desirability of interagency coordination as the position and resources of the agencies warrant.

A first step in interpretation is forging a link between agencies and local communities for the benefit of both. This effort should focus on education and can be pursued in a number of different directions. The following specific efforts are suggested:

1. The Forest Service, because its resources are currently better known, should publish a booklet describing cultural resources on the National Forests, interpreting the same, describing their existing and potential value to the community, and mentioning the laws that protect these resources.

The preparation of descriptive material and illustrations for such a booklet should be in such a form that it can be distributed at district offices, at some campgrounds, and to interested local educational groups.

2. A slide and tape program should be developed. The necessary slides are already on file. Thirty and sixty minute talks to accompany the slides could be taped. The program could be a cooperative effort between federal and state agencies.

3. Contacts should be initiated with local schools, church groups and service clubs and talks to these various groups scheduled.

The potential in this area is almost limitless. I have talked about the archeology of the area in forums ranging from service clubs to priesthood meetings. There are enough different educational, religious, and civic groups in the vicinity of this overview area that a schedule of one or two talks a week is not an impossibility. Given that the program is updated each year, this program could be continued indefinitely. Its implementation would require either full time assistance of someone with public education skills or training one or more individuals in handling the program. Alternatively, the taped talk could be used for the verbal portion of the program.

Additional attention should be given to schools in the area. Segments of the social studies curriculum deal with local history and prehistory and with American Indians. At these points in the curriculum, agencies can provide major assistance in enriching the education of local students through the presentation of talks, the loan of artifactual materials, arranging visits to sites, and providing booklets on local prehistory. Efforts in the schools should be given high priority--the education of the next generation is a more productive path to protecting resources than changing the behavior of this one.

In the case of service clubs a somewhat pecuniary addendum is in order: to the extent that the resources are preserved and developed along some of the lines to be

discussed later, the community will benefit economically.

4. A program of weekly or monthly press releases to local radio stations and newspapers should be initiated.

By the end of 1981, a wealth of digested material on the cultural resources of the overview unit will be available. At regular intervals, short (100 to 200 word) stories discussing a specific aspect of local prehistory could be released. (I once wrote weekly columns for the Winslow newspaper.) The media are generally willing to publish the information. To the extent that this effort can be regularized into a weekly/monthly archeology column or talk, its impact will be further increased. Since a "local presence" is not so essential to this activity, it might be handled by the Bureau of Land Management.

5. Agencies should foster the development of local archeological societies.

Whetting local interest in archeology without providing a means of satisfying that interest would be a mistake. An immediate means of providing a way of actually involving local citizens in archeology is founding a chapter of the Arizona Archaeological Society. This organization currently has chapters in a number of cities and towns throughout the state. Its members are active in visiting sites, and have been involved in field work both on a paid and volunteer basis.

One or more local societies would, on the one hand, provide a group of concerned local citizens with which a variety of cultural resource efforts could articulate, and on the other hand, a pool of manpower of a variety of different tasks that might be undertaken. Direct involvement could involve the forest archeologists playing a guiding role in the founding of the society(ies), the provision of meeting facilities, the use of sites on the National Forests for some of the early field trips, and, possibly, for field work training and experience as has been done on the Coconino National Forest.

## Display Program

Goal: To provide brief visual interpretations of prehistory to visitors.

1. The agencies should produce a poster concerning archeology and cultural resources for display at district offices, campgrounds, and other appropriate public locations.

This program is intended as a quick-and-dirty means of generating a display program. It would consist of a silk-screen, multi-color poster with illustrations of a few interesting artifacts from the overview unit and three messages: (1) a brief summary of local prehistory (200 words), (2) a discussion of the value of cultural resources (100 words), and (3) A warning concerning the illegality of collecting (50 words).

2. A series of roughly 1 meter by 1 meter display boards for use at district offices should be produced.

These displays are intended as more sophisticated versions of the posters. Rather than illustrations, reproductions of artifacts would be attached to a solid wood background. The prose could be somewhat more extensive than that on the posters. Still, it should be possible to produce them for not more than $25 to $50 each.

3. The agencies should produce a set of "archeological columns."

I use the jargon for want of a better term to describe the display I have in mind. Basically, it consists of a wooden box 1 meter on each side and 2 meters high. Two sides of the box are flat panels. On these sides there are prose descriptions of local prehistory on one side and of some specific aspect of the location where the column occurs on the other. The specific discussion might focus on a nearby site, the nature of the prehistoric occupation of a particular canyon or district, or simply on some interesting aspect of regional prehistory--the earliest corn cobs, the abandonment of the National Forest, etc.

The other two sides would be sealed cases. In one there would be a diaroma showing a reconstruction of one of the more interesting sites in the vicinity. In the other, there would be reproductions of chipped, ground stone and/or ceramic artifacts along with some interpretation of them.

This proposal is the heart of the display program. It is intended to be completely

flexible. The columns could be located at district offices, in campgrounds, outside Post Offices, along highways--anywhere that made sense. The intention is to fit the specifics of each column to the location where it is found.

A column at Correjo Crossing, for example, would describe the importance of the homestead there in local history. One at the I-40 rest area near Hibbard could focus on Chevelon Ruin, right across the Little Colorado River and in clear view from the rest area. One at the Forest Supervisor's office would more likely deal with National Forest prehistory in general. Columns could occur singly or in groups. An excavated site might have several columns interpreting it and illustrating the work that was done there. Initial construction costs should be no more than $300 to $500 per column and maintenance costs, save for some inevitable vandalism (a factor for which local community interest will again be important), minimal. Once a dozen or more columns existed, it would also make sense to distribute a mimeographed sheet of their locations so that visitors could spend a Saturday or Sunday "touring" the area's archeology as captured in the columns.

## Interpretive Archeology

Goal: To develop a series of archeological parks that the public can visit for their education and enjoyment.

Discussing a large scale excavation-for-interpretation program taxes current understanding of the cultural resources and is difficult without at least some crude notion of likely funding levels. For this reason, my suggestions pertain more to broad principles rather than to specific work at specific locations.

1. The agencies should undertake an inventory of the land lying within 300 meters of major highways and forest roads. The survey should occur along 40 miles of roadway in situations where archeological site density is likely to be high and land-use factors indicate suitability for hiking, camping, etc. The specific 40 miles should be selected so as to provide maximum possible dispersion over the overview unit. Survey should not be done in segments of less than .25 miles in length. The purpose of the survey is to provide an inventory of archeological sites in easy-access situations. This information is unavailable at present. Some high quality sites near roadways are known (e.g., site 203 and the "fort", both along the 504 road). There are other sites with great interpretive potential that are substantial distances from roads (e.g., Stotts Ranch, Bear Ruin, East Lincoln Ridge, Homolovi II).

Reasonable decisions must be based on a balance of archeological potential and fiscal reality. Frequently, this will involve comparing similar sites at varied degrees of access. The survey would provide the data basis from which assessments could be made. "Typical" sites would be selected in easy-access locations. A few sites with particularly difficult access problems but with high interpretive value would be included in the plan. (While this survey is discussed here in respect to interpretation, it has a high priority in both administrative study and protective proposals discussed elsewhere.)

2. Interpretation should focus equally on many different aspects of archeology.

Archeological exhibits saturate the interest of the curious when they become monotonous. This is most likely to occur when displays are all of the same type--all excavated rooms for example. To avoid this problem, displays should have a number of different foci including, but not limited to:

(a) excavation--when possible visitors can be directed to sites where they can watch ongoing excavation.

(b) survey--a transect-size area is fenced and the visitor is challenged to find the sites, fill out a sample site form, etc.

(c) vandalism--a particularly badly potted site could be used to show what pothunters destroy that archeologists can learn from.

(d) site formation processes--the descriptive material at and the tour of, the site focus on how the site came to be as it is. The depositional and post-depositional processes that created the site are illustrated.

(e) settlement patterns--a walking tour along trails through an area of dense but

unexcavated sites to provide an understanding of inter-community patterns.

(f) excavated sites--to show architecture, activities, etc.

3. Interpretation of sites should encompass multiple-use goals.

The goals of educating the public concerning cultural resources and multiple use management should be amenable to mutually reinforcing display strategies. Each prehistoric family was involved in a multiple use approach to the resources of the area in a way that the typical modern family is not. Most modern families utilize the area in very limited ways--for recreation, for Christmas trees, for grazing the family herd. They are not dependent on nearly so wide a range of resources as were prehistoric peoples.

It is only the agency that is in a position to view the entire set of resources and to act for effective resolution of competing use needs in the same way that prehistoric families did. A prehistoric family needed wood for fuel and for construction, but cutting the juniper and pinyon trees reduced the availability of food stuffs and, in some cases, may have changed the climatic regime. In summary, discussions of how prehistoric families met their resource needs may be an effective means of explaining multiple use strategies to the public.

At the same time, such an approach can help to directly and indirectly educate the public concerning cultural resources. First, the very use of the analogy is a means of educating the public to the potential importance of studying the past: at least some prehistoric peoples did mismanage their resources and had to abandon the areas where they lived. Second, specific cultural materials could be used in illustrations.

This approach could be implemented in a variety of ways. Pamphlets could be written that describe the history of multiple-use of public lands from earliest prehistoric to modern times. Archeological sites could be moved to, or reconstructed in, multiple-use demonstration areas. Finally, descriptive material in all archeological exhibits should make reference to the multiple-use concept.

4. Excavation and restoration should be directed to low maintenance products. Self-guided walking tours, sufficient to allow the handicapped access and at least occasionally specifically directed to particular handicapped groups, should be the norm at all exhibits. When camping facilities are associated with the exhibits, they should be pack-it-in, pack-it-out facilities. Displays should be archeological columns as described earlier.

5. There should be some provision for seasonal supervision of the sites. Interpretation would be greatly aided by two or more archeologically trained seasonal employees who spend portions of each week at different sites giving talks, answering questions, etc. These same employees could provide campfire talks at the larger campgrounds.

6. There should be local involvement in the planning, development, and operation of the interpretive program. The interpretive program is a community resource. If it succeeds, the increase in tourist dollars in the area will be substantial. Beyond economics, local citizens and their guests will be frequent visitors at the facilities. Finally, the public is an expert advisor as to what the public would like to see in such sites. One recent evaluation of the characteristic attitude of visitors to archeological and historic exhibits is that they are bored (Leone 1978). This comment taken in conjunction with the rapidly increasing rate of visitation suggests that the public wants more from such exhibits than it is currently getting.

After planning, volunteers of time and resources can greatly assist in excavation and development. Later, volunteers could carry on demonstration excavation programs and even serve as docents for particular exhibits. Finally, volunteers and an interested local community can provide the ultimate protection for those exhibits.

7. Interpretive development should be done at an interagency level. The development of major interpretive exhibits should be primarily a National Forest responsibility. A great potential would be lost, however, were there not some interagency cooperation,specifically between the Apache-Sitgreaves, Tonto and Coconino National Forests and the BLM. Four of the

largest and most interesting sites in the area are near Winslow (Nuvaqueotaka and Homolovi), Payson (Shoo-fly), and Heber (Stotts Ranch). Developing these sites with a degree of coordination so as to facilitate a driving tour of the archeology of the area would enhance the interpretive value of each. The nascent "Hopi Origins Project" has a similar potential for cooperation between the forests and the Bureau of Land Management.

## ADMINISTRATIVE STUDIES

There are undoubtedly effective means of managing cultural resources that are not described in this document because they have not been tried. Administrative studies are necessary in a number of areas to improve management strategies.

1. Low density artifact scatters. For reasons discussed earlier, a fuller understanding of low density artifact scatters could have immediate benefits to management activities.

2. Site signature study. The agencies now are in possession of high quality air photos. It is essential to determine as quickly as possible the potential utility of these in locating cultural resources. An appropriate procedure involves using a stereo viewer to find esoteric vegetation or soil patterns that may represent archeological site "signatures." These locations are then checked for "ground truth," to determine which signatures are false and which are in fact indicative of sites. Control of typical site signatures in an area--and they cannot always be found--is a means of quickly estimating the likelihood of finding resources in a particular project area.

3. Site formation processes baseline. Quite apart from specific human impacts that result in the deterioration of the quality of the archeological record, there are a variety of continuing unpreventable natural impacts, such as trampling by herd animals, excavation by rabbits, badgers, coyotes, etc. In discussing the impact that a particular project has on a resource, it would be very useful to have some standard other than "the pristine archeological site" with which to compare a probable impact.

To establish such a baseline, it would be necessary to generate information on roughly 100 randomly chosen archeological sites in the study area. The sites should be in a variety of different locational contexts (both cultural and natural) and should have suffered a variety of obvious previous impacts. Low level air photos of the sites requiring probably 10 hours of helicopter time could be used to generate site maps and for an overall assessment of current major impacts. Roughly 1 day of collecting at each site using a formal grid system would provide a basis for a baseline characterization of the artifactual materials. In addition, some artifacts would be field analyzed and left in situ.

Periodic studies at a sample of these sites each year in 10 year intervals would provide a relatively continuous monitoring of the impacts the sites suffer. Given the continuation of the study for several decades, it is likely that land modification and other projects will be carried out in their vicinity, allowing a comparison of a great range of different impacts.

4. Site surface renewal. A few sites in the study area have been collected several different times within the last 100 years. Partial collections have been made from over 2000 sites. The rapidity with which the surface of sites is renewed is an important consideration in evaluating impacts. If the artifacts that occur on the surface of a site at some point in time are a subset of all those that have ever been there and the set that contains those which will be there in a decade, then protection against surface impacts is a significant consideration. Alternatively, if the surface of a site is "renewed" at a sufficient rate that the same quantity and types of artifacts endure over long periods of time, then protection against only the most extreme impacts is warranted.

Recollecting a sample of already collected sites and testing to see whether a variety of inferences that might be made using surface materials have changed or remained the same is a beginning. Close articulation between surface renewal studies and the studies described in item 3 are, in the long run, a source of more sophisticated information that may reduce the preventive actions that need to be taken in the face of particular impacts.

5. Sites and fires. The probability is quite high that most archeological sites found on the National Forests have been burned over by a forest fire at least once. The effect of burning on sites in unknown. Yet, that burning may have seriously affected the quantity and quality of materials available on sites.

Bone, for example, is present in subnormal quantities on sites on the National Forests. Yet, there is no obvious characteristic of soil chemistry or hydrology that explains the poor preservation that has been observed. Periodic forest fires may be the cause.

This issue can be addressed by three administrative studies. (1) Excavating sites in an area immediately after a major fire. Especially when some parts of a site have been impacted more than others, the extent of degradation of the archeological record by the fire can be estimated. (2) It is justifiable to use some sites, partially excavated in advance, in areas where slash is to be burned, to begin to understand this impact. (3) Sites could be "built" and then burned.

6. Juniper pushes and animal habitat. Juniper pushes are justified on the grounds that they increase the quantity and quality of grass for animals. The direct impact of Pushes on archeological sites is alleviated when boundaries are shifted to avoid sites. If, as a result of a push, carrying capacity is increased and animals move to the remaining vegetated areas for shade, the indirect impact on archeological sites in the vicinity of the push may be substantial. Archeologists recognize the great destruction that occurs on sites where the density of cattle is high--sherds are very small, chipped stone is characterized by "cow retouch." A systematic before-after study of sites in the vicinity of pushes would help to resolve this issue. There is no reason to believe that pushing would become so overwhelming an impact through greater animal densities so as to make it inadvisable. However, wider boundaries around cultural resources might be warranted.

7. Sampling dispersed parcels such as those managed by Bureau of Land Management is a problem for the reasons discussed earlier. Before a full Phase II survey of the overview area is undertaken, useful information could be gained by comparing the relative results of the two approaches suggested earlier. A sample of about 15 parcels for each strategy should be used. Once the sample is done the predictive power of the two approaches could be compared, by surveying the entire parcel and examining the relationship between the sample and the population.

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BAE - Bureau of American Ethnology.

CARP - Chevelon Archaeological Research Project.

DOA - Department of Anthropology (used with any university).

FMNH - Field Museum of Natural History.

MNA - Museum of Northern Arizona.

Ms. - Manuscript on file at (used with any location).

NAU - Northern Arizona University, Flagstaff.

SAA - Society for American Archaeology.

SWAE - Southwest Archaeological Expedition.

UCLA - University of California, Los Angeles.

UNM - University of New Mexico.

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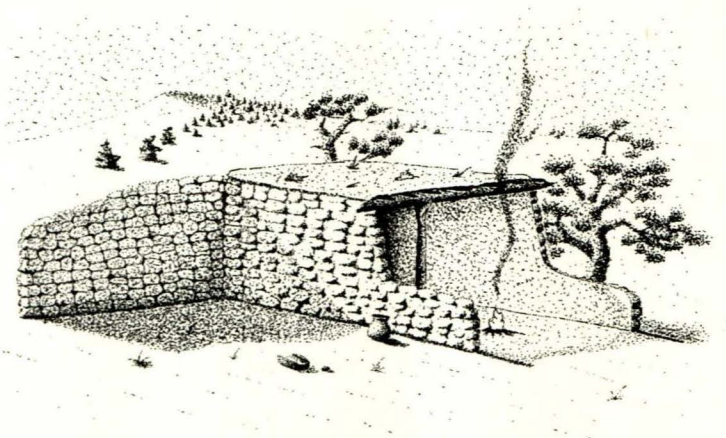

Artist's reconstruction of Puebloan "carport" site.

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